

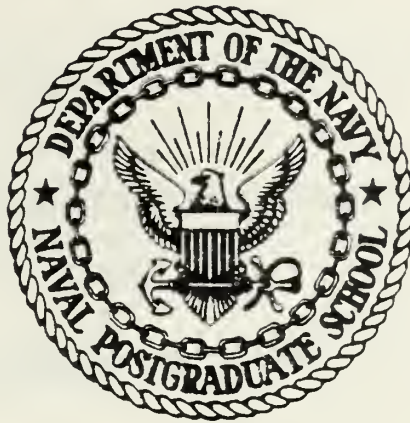
ATHENA: A SYSTEM TO INTERACTIVELY ANALYZE  
LARGE SCALE OPTIMIZATION MODELS

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# NAVAL POSTGRADUATE SCHOOL

## Monterey, California



# THESIS

ATHENA: A SYSTEM TO INTERACTIVELY ANALYZE  
LARGE SCALE OPTIMIZATION MODELS

by

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ATHENA: A System to Interactively Analyze  
Large Scale Optimization Models

by

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## ABSTRACT

The analysis of the solutions of large scale optimization models is very difficult without computer aids because typical outputs may exceed 40,000 lines. A computer system to allow efficient storage and interactive analysis of the solution file was designed and implemented in FORTRAN. This system, called ATHENA, has been initially designed for problems with up to 30,000 rows and columns; tests show the system has fast response time for these large problems. A description of the system, its data structures and commands as well as a user's manual is included.



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## I. INTRODUCTION

The generation, solution and analysis of large scale mathematical programming models presents significant problems in data handling. For a typical large scale model the output from the computer may exceed 40,000 lines and it is very difficult and time consuming for the user to go through that much paper to extract the information he needs. Space is also needed to store all these outputs and it is difficult to provide routine access to old solution files.

Over the past several years, faculty and students at the Naval Postgraduate School and the University of California at Los Angeles have been cooperatively developing theory and algorithms to solve large scale linear, nonlinear and integer optimization problems. This research has been furthered by the development of several software systems to solve large scale optimization problems. ATHENA is part of that development and was built to satisfy a pressing need to be able to quickly and easily analyze solutions to these large problems.

The research in large scale optimization at the Naval Postgraduate School has concentrated on providing economic solutions to current Department of Defense problems. One such project that was going on concurrent with the development of ATHENA was a large, medium range capital budgeting problem that required the solution of a mixed integer programming



problem with 11,687 constraints and variables [6]. ATHENA was used successfully with this project, and performance of ATHENA on this problem is reported below.

System ATENA has been developed to handle output from these large optimization problems by enabling the user to get the information he needs interactively through a computer terminal and by economically storing the large files in packed form in low cost media. The features of the system may be summarized as follows:

1. Quick and accurate answers to simple questions that are tedious and error prone to address manually, e.g.,

How many of a set of variables are = 1.0?

or How many are greater than 0?

or What variables are in a specified range?

or What constraints are satisfied exactly? Etc.

2. In large scale mathematical programming models the names of rows and columns are constructed systematically so that groups of variables with relationships in the real world have similar names. Using the system one can have automatic, easy and accurate answers for many interesting properties of these groups. (For instance, the average value of all the variables whose names begin with X, etc.)

3. ATHENA can also be used as a basis for a simple report writer.

4. The system provides very compact computer storage: the original solution file is typically packed into 1/10 of its normal volume. For example, a solution file from the



IBM MPS/360 package of a linear programming model with 12,000 rows and columns occupies 1.5 magnetic tapes 2400 feet long at 800 BPI in original unblocked form, but in packed form the solution occupies approximately 31 feet of magnetic tape.

5. There is systematic and economic file organization with easy and accurate access.

6. A file structure for multiple runs of the problem for comparisons is available.

7. The system requires modest resources (core, time) in a time sharing environment for a large amount of data.

8. The system has portability and allows easy change or expansion since the whole system has been developed in FORTRAN.

ATHENA was inspired by a similar system developed for the Department of Energy by O'Neil and Sanders [5] called PERUSE. PERUSE was developed to aid in the analysis of large linear programming energy models. A study of the needs of Naval Postgraduate School students and faculty showed that additional capacities beyond those in PERUSE were necessary to support current and future research in large scale optimization. In addition to the standard MPS output, it was determined that ATHENA should support the experimental optimization system XS [3]; the output of this system contains in addition to standard MPS output, upper and lower penalties that implement the 'elastic formulation' of linear models that is unique to XS. ATHENA also had to support the





use of a preprocessor PREP [2] that reformulates the original optimization problem to an equivalent reduced problem with fewer rows and/or columns. A study of past and current modeling efforts at the Naval Postgraduate School identified additional commands that would help in the analysis of large models.

ATHENA was designed to be as much as possible a direct extension of PERUSE. Almost all the commands and options of PERUSE have been included with the identical names and syntax whenever possible. A summary of the extensions is listed under the section LIMITATIONS - EXTENSIONS, of the user's manual.



## II. SOFTWARE DESCRIPTION

### A. GENERAL

The whole system consists of 3 basic subsystems (see Figure 1).

#### 1. PARSER - Code Generator

This subsystem accepts as input a Query, parses it examining the syntax according to the productions of the Query Language and generates the corresponding internal code or gives information for syntax errors. The internal codes for each Query are shown in the program list.

#### 2. Input

This subsystem accepts as input either (1) an unpacked solution file in 'standard' format which it packs and saves for future reference, or (2) an L.P. solution file in packed form from a previous session.

#### 3. Interpreter

This subsystem, using the code generated from the PARSER, searches the packed solution file and prints out the information requested.

### B. LANGUAGE

#### 1. Host Language

The system has been developed in a portable subset of FORTRAN IV. FORTRAN was chosen for the following reasons:

a. FORTRAN is a general language available at almost any computer installation, so the system can be used with



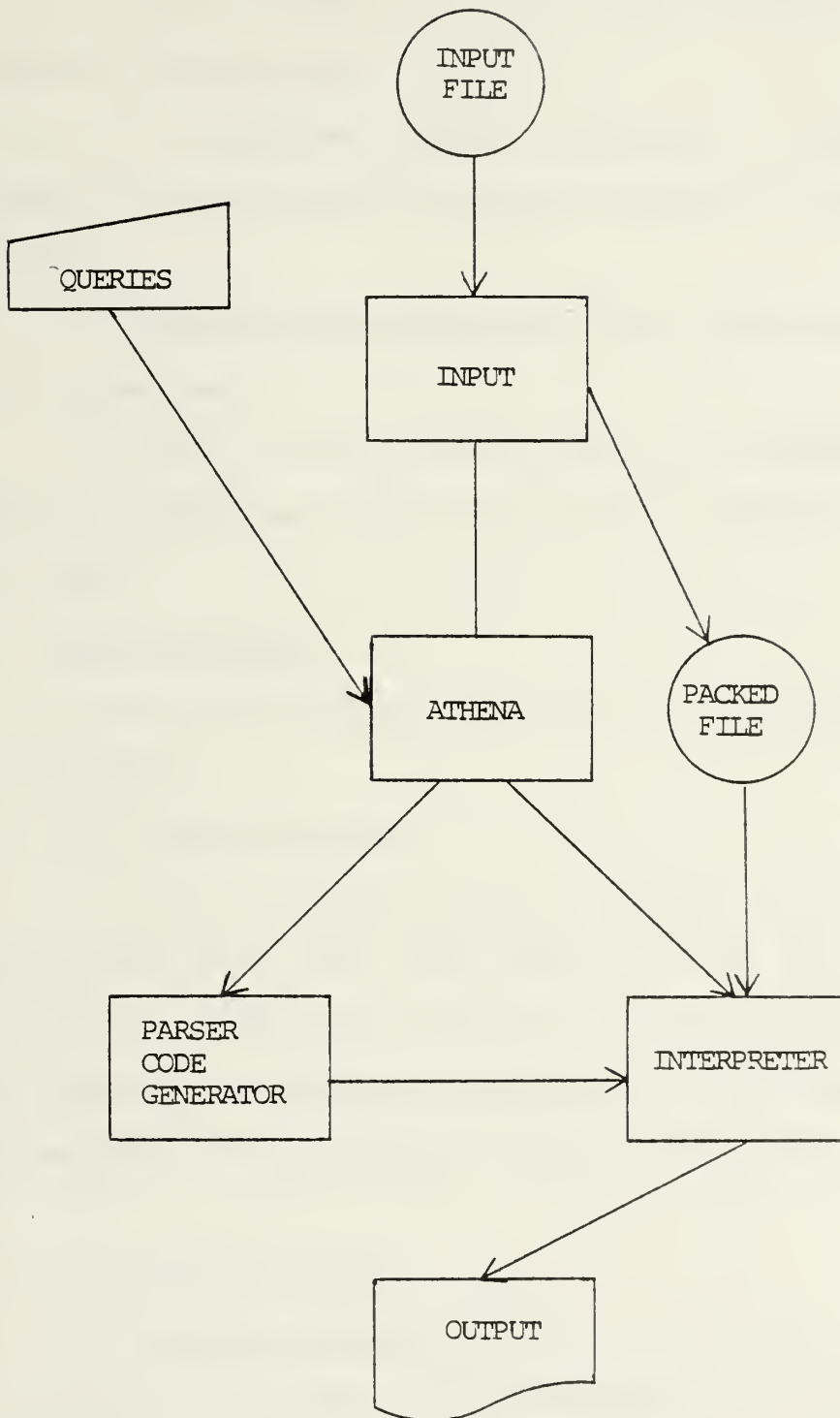


FIGURE 1. System ATHENA



any contemporary hardware. Non-IBM systems may require some program modifications.

b. Since FORTRAN is a high level language, the development time was low.

c. The response time for each Query is acceptable and there is little need for faster responses or enhanced efficiency.

d. Extensions and changes of the system can be easily implemented.

e. There is good system support for FORTRAN. In particular, ATHENA was developed with the FORTRAN G compiler of IBM 360/67.

## 2. Query Language

The set of acceptable Queries is divided into two main categories:

### a. Control Queries

Control Queries provide commands to the system to perform specific tasks, but usually do not use the solution file. Examples of Control Queries are those that accept comments for self documentation of the output, print headings for the output, terminate the use of system, etc.

### b. Command Queries

Command Queries use the solution file to extract the information asked for. Each Command Query consists of various fields separated by at least one blank. Some of the fields are optional, while others are required. An internal code number is generated by parsing the Command Query for





each field depending upon the analysis of that field and the previous fields in the Command Query.

The code generated by the PARSER is executed by the INTERPRETER which consists of a set of programs (subroutines) activated by the code numbers, to get the required information from the file.

## C. DATA STRUCTURES

### 1. Preview

There are some observations about the solution file of a linear program, especially of a large scale one, that lead to the use of a special data structure for storing a solution file in less memory space than it would otherwise require.

For each row or column the following information is usually included in the solution file.

NUMBER of row or column.

NAME, usually 6-8 alphanumeric characters.

STATUS, usually 2 characters, e.g., BS for BASIC, LL for LOWER LIMIT, etc.

ACTIVITY LEVEL, for each row or column.

SLACK ACTIVITY for rows or INPUT COST for columns.

LOWER LIMIT

UPPER LIMIT

DUAL ACTIVITY for rows or REDUCED COST for columns.

UPPER PENALTY and

LOWER PENALTY for the elastic linear programming system, XS [3].



There is redundant information in each record. Some of these redundancies are the following:

The explicit number for each row or column may be represented implicitly by the ordinal position of the row or column in the file. Rows usually precede columns in solution files.

A large number of the ACTIVITY LEVEL values will be zero. The same is true for the SLACK ACTIVITY, LOWER LIMIT, DUAL ACTIVITY and PENALTY values.

In many cases there will not be LOWER or UPPER LIMITS or PENALTIES.

PENALTIES in some cases may be infinite.

When the status of a row or column is 'fixed', then ACTIVITY LEVEL, LOWER and UPPER LIMITS are all the same number.

Each row or column can be in only one of its possible states.

Moreover, analysts who have experience with large scale Linear Programming have observed that most of the numbers of the solution file are the same. For example, most of the numbers for LIMITS are the same for a large number of rows or columns. For purposes of analysis, it is rarely necessary to have more than five decimal digits of precision for problem values. Indeed, some large problems cannot be solved with even this degree of significance. Accordingly, IBM single precision REAL\*4 representation



is adequate for our purposes. Conversion to REAL\*8 extended precision requires trivial program modifications.

Based on the above observations, two types of data structures for storing the solution file have been developed. The first one (SPARSE) exploits the redundant information into each individual record. The second (SUPERSPARSE) takes advantage of the last observation by storing each distinct number only once for the entire file. It is the responsibility of the user to select the data structure type that is appropriate for each solution file. SUPERSPARSE is probably superior for problems with less than half of all numbers possessing distinct real values. What follows is a detailed description of these two data structures.

## 2. SPARSE Data Structure

The entire solution file is stored in contiguous memory (8-bit bytes) as a one-dimension array called SOLFIL, in the following way:

a. The first 16 bytes (Four 4-byte words) are used to keep information for:

(1) The size of the file in 4-byte words.

(2) The type of data structure used to pack the file (SPARSE or SUPERSPARSE).

(3) The number of rows and columns of the file.

b. For each row or column, 12 sequential bytes are required, organized as follows (see Figure 2).

(1) The first 8 bytes hold the name of the row or column left justified, one character per byte.



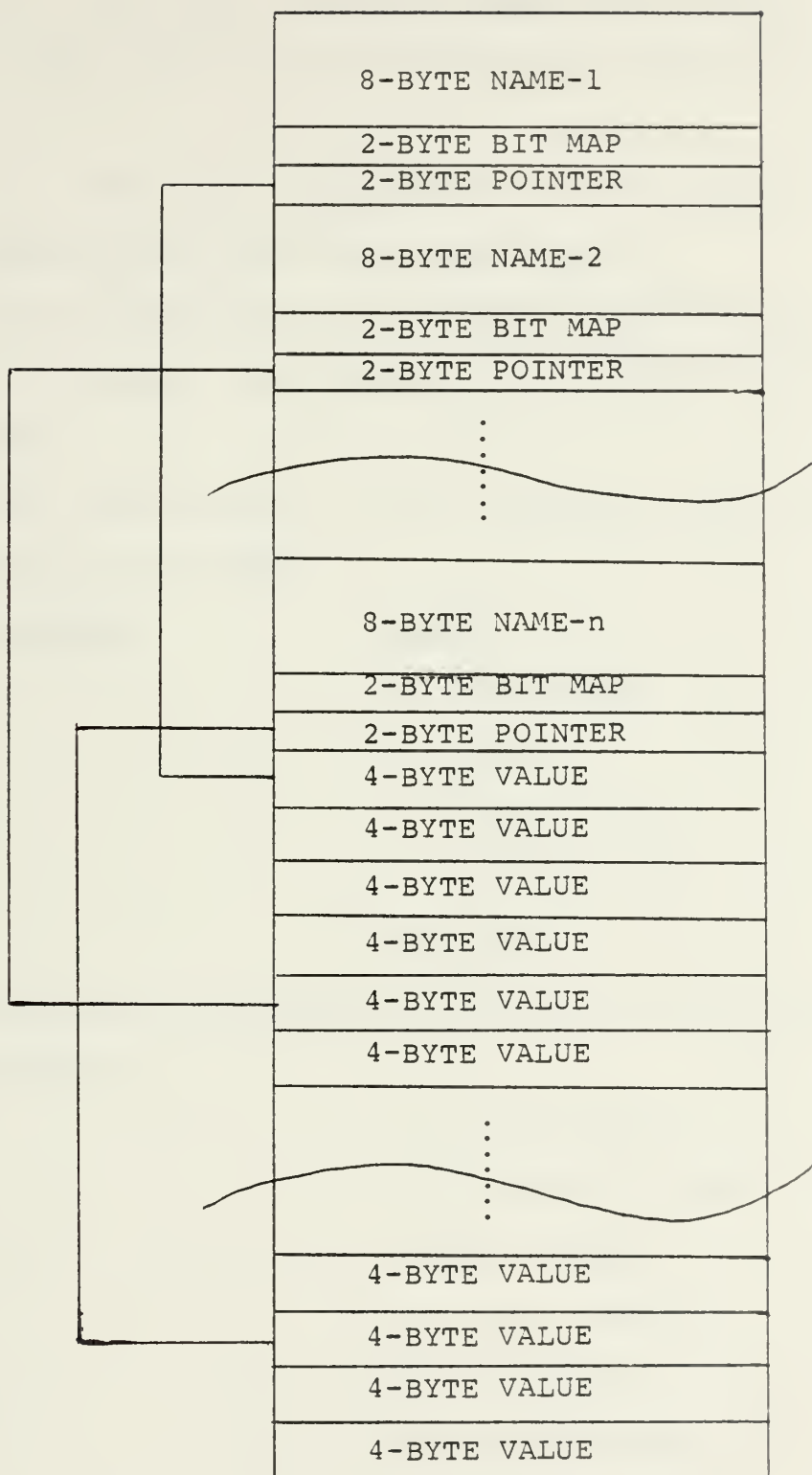


FIGURE 2. SPARSE Data Structure





(2) The next 2 bytes are used (as 16 bits) to represent various characteristics associated with that row or column.

(3) The last 2 bytes are used as a pointer to the first number stored from the current record.

c. The 16 bits from (2) above are organized in 4 groups of 4, 7, 4 and 1 bits, respectively, taken from higher to lower order.

The first group of 4 bits represents the status of the current row or column.

<u>BIT</u>	<u>PATTERN</u>	<u>STATUS</u>
0 0 0 0		IN (INFEASIBLE)
0 0 0 1		BS (BASIC)
0 0 1 0		LL (LOWER LIMIT)
0 0 1 1		UL (UPPER LIMIT)
0 1 0 0		EQ (FIXED)

The following status indicators are reserved for use with the program PREP [2]

0 1 0 1	VC (VOID COLUMN)
0 1 1 0	SC (SINGLETON COLUMN)
0 1 1 1	FC (FIX COLUMN)
1 0 0 0	BC (BOUND CHANGED)
1 0 0 1	VR (VOID ROW)
1 0 1 0	SR (SINGLETON ROW)
1 0 1 1	RR (REDUNDANT ROW)
1 1 0 0	FR (ROW FIXES VAR. AT BOUND)
1 1 0 1	ER (DOUBLETON EQUATION)



1 1 1 0

TR (TIGHTEN RANGE)

1 1 1 1

PP Reserved for PREP[2]

The next group of 7 bits represents the characteristic of zero or nonzero values for the record.

<u>BIT NO:</u>	<u>BIT VALUE:</u>	<u>CHARACTERISTIC</u>
11	0	ACTIVITY LEVEL NONZERO
	1	ACTIVITY LEVEL ZERO
10	0	SLACK/COST NONZERO
	1	SLACK/COST ZERO
0	0	LOWER LIMIT NONZERO
	1	LOWER LIMIT ZERO
8	0	UPPER LIMIT NONZERO
	1	UPPER LIMIT ZERO
7	0	DUAL/RED. COST NONZERO
	1	DUAL/RED. COST ZERO
6	0	LOWER LIMIT EXISTS
	1	LOWER LIMIT DOESN'T EXIST
5	0	UPPER LIMIT EXISTS
	1	UPPER LIMIT DOESN'T EXIST

The next group of 4 bits represents the characteristics for PENALTIES.

<u>BIT PATTERN</u>	<u>UPPER PENALTY</u>	<u>LOWER PENALTY</u>
0 0 0 0	ZERO	ZERO
0 0 0 1	ZERO	NUMBER
0 0 1 0	ZERO	INFINITY
0 0 1 1	NUMBER	ZERO



0 1 0 0	NUMBER	NUMBER
0 1 0 1	NUMBER	INFINITY
0 1 1 0	INFINITY	ZERO
0 1 1 1	INFINITY	NUMBER
1 0 0 0	INFINITY	INFINITY

The rest of the bit permutations are not used.

The last (0 bit) is used by the interpreter to mark the active and nonactive records when the user uses the ACTIVE or DEACTIVE commands to avoid searching of the entire file.

All the above groups of bits are stored together as a 16 bit binary number, which is stored in 2-byte halfword. ATHENA has provisions for the use of 16 bit halfwords representing absolute magnitudes of 0 - 65535, and can extract any component bits of the halfwords as necessary. (In this sense, the usual signed magnitude of IBM/360 halfword integers is ignored.)

d. The (nonzero, noninfinite) number values which must be stored are located immediately after all the information above. If the file represents a problem with M rows and N columns, then location INDEX - where  $INDEX = (N+M) * 3 + 4 + 1$  - of the SOLFIL array is the first eligible location for storing number values. The value of INDEX is kept in a 2-byte pointer associated with each row and indicates for that row the location of the first value stored. The sequence for storing these numbers for each row is:



ACTIVITY LEVEL, SLACK/INPUT COST, LOWER LIMIT, UPPER LIMIT, DUAL/REDUCED COST, UPPER PENALTY, LOWER PENALTY.

### 3. SUPERSPARSE Data Structure

This type of data structure takes advantage of the fact that in most problems many number values in the solution file are the same. Each distinct value is stored only once and a 2-byte pointer is used to access this value when needed. This is the only difference from the SPARSE representation (see Figure 3).

The array with the packed solution file is now separated into 3 parts:

- a. The first part is exactly the same as in SPARSE.
- b. The second part is substantially the same with the following differences:

- (1) It consists of 2-byte halfwords instead of 4-byte words.

- (2) Each halfword is a pointer to the third part of the array where the distinct number values are stored.

- c. The third part consists of a pool of 4-byte words, each representing a distinct real number value. The pointers to the distinct real number values are relative addresses in the real number pool, so a file which is packed with a different array size can be used with the current pointers providing the array size is large enough to hold the file.





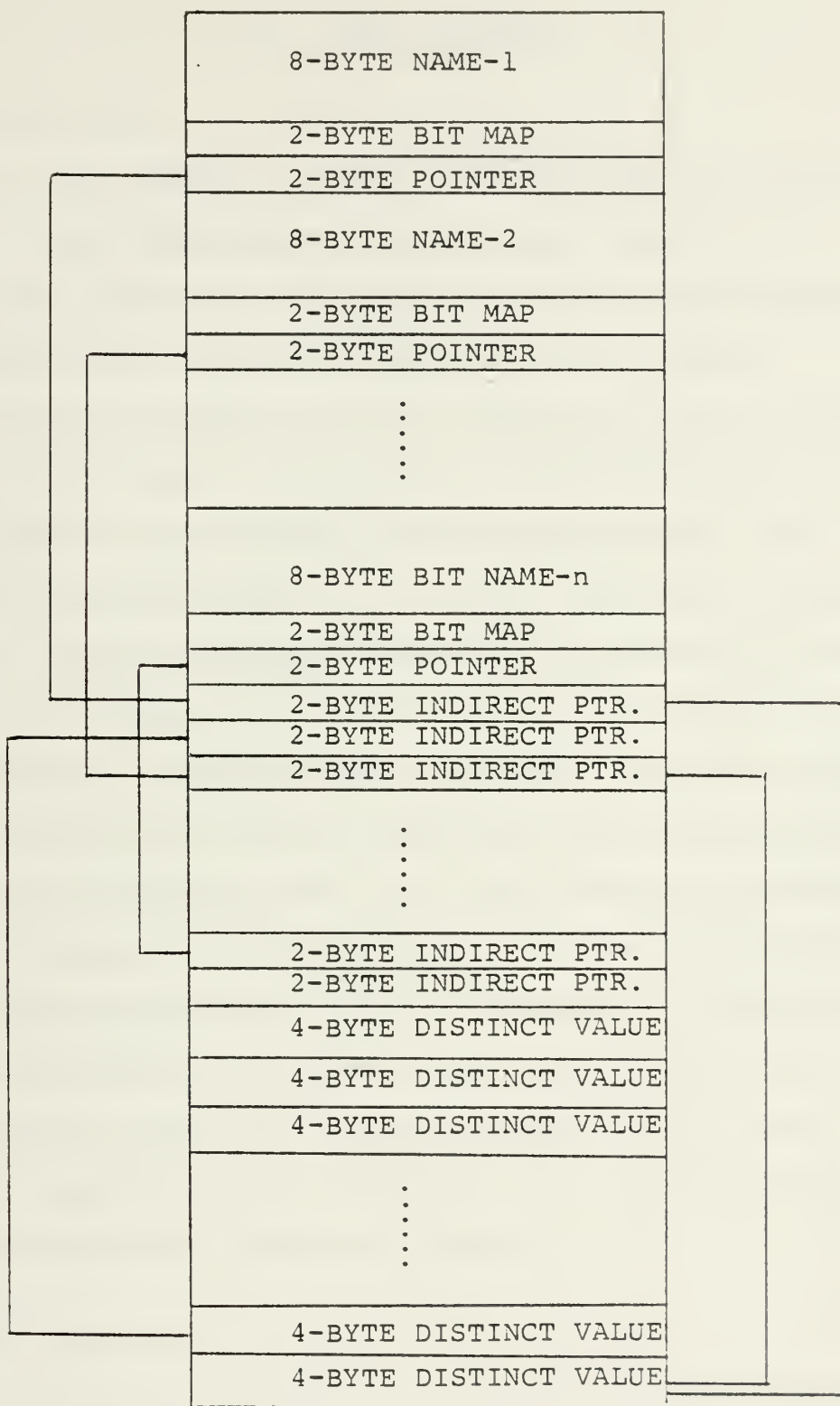


FIGURE 3. SUPERSPARSE Data Structure



### III. USER'S MANUAL

#### A. INTRODUCTION

The system ATHENA is a set of programs which accepts as input a linear programming solution file, packs it in a special data structure and interactively extracts specific information from that file through a set of Queries.

The size of memory which is required to run the system depends on the size of the file to be accommodated, and thus on the size of the original optimization problem. The user extracts information from the solution file with a Query Language, asking questions related to the solution of the problem represented in the file.

The entire system has been developed in FORTRAN language for portability and better coordination with other Linear Programming procedures which are also written in FORTRAN.

The Queries are self-documenting and their syntax follows closely the syntax of the English language. To avoid typing effort for experienced ATHENA users, short forms of Queries are provided. Only the characters comprising the short forms are interpreted by the system, with all subsequent contiguous nonblank characters ignored.

#### B. QUERY LANGUAGE

The Query Language consists of three subsets of Queries:



### 1. The Control Queries:

With this subset of Queries the user controls mainly the output of the system, inserting comments, headings, etc.

### 2. The Command Queries:

With these the user communicates with the solution file and extracts the specific information he needs.

### 3. The SET Command.

This command qualifies the ATHENA queries to access only a subset of the problem file.

#### 1. Control Queries

##### a. VERIFY (Short Form V)

All the following Queries will be displayed with the output. This Control Query is useful when the OFFLINE printer is used for the output instead of the terminal, or when the system is used under Batch Processing; in these cases answers are transmitted to the output device without the corresponding questions if the system is not in VERIFY mode.

##### b. NOVERIFY (NOV)

The following Queries do not appear with the output. This Control Query is most frequently used when a terminal is used for all output. The DEFAULT mode of the ATHENA system is NOVERIFY.

##### c. PROMPT (P)

The system responds with the prompt:

' INPUT A COMMAND '



whenever it is ready to accept a Query. PROMPT is a DEFAULT mode of the system.

d. NOPROMPT (NOP)

Used to avoid the prompting phrase in the output, especially when the OFFLINE printer or the Batch Processing is used.

e. H Any Character String

When the first column of a Query is the letter H, then the character string is printed as is in the output. H is used to insert comments or headings in the output.

f. \* Any Character String

When the first column of a Query is the character \*, no action takes place. This is considered as a comment and is ignored. \* is useful to insert comments and/or headings on the terminal output.

g. END (E)

Used to end the current session.

2. Command Queries

A Command Query consists of several fields. Some fields are required and must always appear in a Command Query and others are optional. Each field is separated from the others by at least one blank character. The number of blanks between fields is not significant and a Query may start at any character position in the command. The length of a Query cannot exceed 80 characters including the spaces between the fields.





The possible fields that can be included in a Command Query are:

- a. TYPE
- b. SELECT
- c. MASK
- d. CONDITION
- e. PRINT OPTION

The fields in a Command Query must appear in the above sequence and the first 3 of them must always appear, with only 2 exceptions. A detailed description follows of each individual field and the way that it may be used.

a. TYPE field

This is the first field of the Query and may start at any character position. This field can be one of the following:

(1) DISPLAY (D)

Used when all the records which meet the requirements of the other fields are to be displayed in the output in the sequence they are encountered starting from the beginning of the solution file.

What portion of each individual record will be displayed depends on the PRINT OPTION field.

(2) COUNT (C)

Used when only the number of records which meet the requirements of the other fields is desired. COUNT is especially useful immediately preceding a DISPLAY command so the user will know in advance the size of output, avoiding



unpredictably extensive printouts. For this Query the PRINT OPTION is ignored as meaningless.

(3) ADD (A)

Used when some numerical quantities of the qualified records are to be summed. The names of the numeric quantities of each record that will be added are given in the PRINT OPTION field. If no PRINT OPTION appears, all the numeric quantities of each record are added and their sums are displayed with appropriate labels.

Since it is mathematically meaningless to add LOWER or UPPER LIMITS, or PENALTIES, they can not be summed or displayed.

(4) AVERAGE (AV)

Used exactly as the ADD command to display arithmetic averages. The sums are divided by the total number of the qualified records.

(5) ACTIVATE (AC) (Syn. ACTIVE)

With the ACTIVATE command the user can indicate a subset of the records of the solution file with specific qualifications determined by the other fields so that subsequent Queries will implicitly refer only to that subset. The user can expand the initial subset by using the ACTIVE command repeatedly to add new records to the active subset.

The command ACTIVATE can minimize the searching time for the required information in the active subset. Each time the ACTIVATE command is issued, the system



responds with the number of records added to the active subset and the current total number of active records.

(6) DEACTIVATE (DE) (Syn. DEACTIVE)

Used to delete records with specific qualifications from the current active subset - created by the ACTIVE commands - or to eliminate any active file. The system responds with the number of records deactivated and the total number of records remaining active.

The entire active file can be deactivated by:

' DEACTIVE ALL or DE A'.

With this Query all the currently active records will be deactivated and the message:

' F I L E D E A C T I V E '

will be printed out. Subsequent queries will refer to the entire solution file.

b. SELECT field

This field is mandatory and specifies whether the qualified records are ROWS, COLUMNS or BOTH. It may consist of one of the following:

(1) ALL (A)

Specifies that the entire file must be searched for the qualified records starting from the first ROW and continuing to the last COLUMN.



(2) COLUMNS (C)

Specifies that the COLUMNS only will be searched for the qualified records starting with the first COLUMN and continuing to the last COLUMN.

(3) ROWS (R)

Specifies that the ROWS only will be searched for the qualified records starting with the first ROW and continuing to the last ROW.

c. MASK field

Specifies that any record is qualified for processing if the name of the record fits the MASK field. The MASK field is left justified and may contain 1 to 8 characters. All the right unfilled positions up to 8 characters are assumed to be the character \*. The MASK is matched against the name, starting from the left, character by character. Any character in the name is matched with a \* in the MASK field. The MASK field is mandatory.

EXAMPLES

i. The MASK 'X\*\*\*\*\*Y' specifies all the names starting with the letter X and having as the 8th (last) character the letter Y.

ii. The MASK 'X' is equivalent with the MASK 'X\*\*\*\*\*' and means all the names starting with the letter X.

iii. The MASK '\*\*\*\*\*Y' specifies all the names ending with the letter Y and it is NOT equivalent with the MASK 'Y'.





iv. The MASK 'ABCDEFXY' specifies only this name and since the names of ROWS and COLUMNS are assumed to be inclusively unique, the searching of the file stops when the first match is made.

v. The MASK '\*' specifies ALL the names and may be used when no particular mask is desired.

d. CONDITION field

The syntax of this field is:

FOR ( <conditional phrase> )

The word FOR, left parenthesis and right parenthesis must always appear when the CONDITION field appears in a Query.

There are two kinds of conditional phrases:

The simple conditional phrase and the compound conditional phrase.

(1) Simple Conditional Phrase

There are 3 kinds of simple conditional phrases: The Relational, the Status and the Bound simple conditional phrases.

(a) Relational Simple Conditional Phrase

The syntax is:

<Arg1> <Relop> <Arg2>

where Arg1, Arg2 and Relop are one of the following:

i. Arg1

X	for	ACTIVITY LEVEL
S or C	for	SLACK ACTIVITY or INPUT COST



L	for	LOWER LIMIT
U	for	UPPER LIMIT
D	for	DUAL ACTIVITY or REDUCED COST
P	for	UPPER PENALTY
W	for	LOWER PENALTY

## ii. Relop

Relational operators EQ, NE, GT, GE, LT, LE with the same meaning as in FORTRAN. (Note, however, that there are not imbedding decimal characters as in FORTRAN.)

## iii. Arg2

Arg2 is defined exactly as Arg1 with the enhancement that Arg2 may also be any integer or real number. Arg2 cannot be expressed as a floating point number in exponential notation.

## (b) Status Simple Conditional Phrase

The syntax is:

STATUS <Flag> or ST <Flag>

where Flag is one of the following:

BS	for	BASIC
LL	for	LOWER LIMIT
UL	for	UPPER LIMIT
EQ	for	FIXED
VC	for	VOID COLUMN
SC	for	SINGLETON COLUMN



FC	for	FIXED COLUMN
BC	for	BOUND CHANGED
VR	for	VOID ROW
SR	for	SINGLETON ROW
RR	for	REDUNDANT ROW
FR	for	FREE ROW
ER	for	DOUBLETON EQUATION
TR	for	TIGHTEN RANGE

(c) Bound Simple Conditional Phrase

The syntax is:

<Arg1> MINIMUM or <Arg1> MAXIMUM

where Arg1 is specified as in Relational Simple Conditional Phrase. The words MAXIMUM or MINIMUM can be abbreviated as MAX or MIN, respectively. This is used to extract those records which have the MAXIMUM or MINIMUM value in the specified field with the specified MASK. The system responds with the first record encountered with the maximum or minimum value associated with Arg1, and the total number of records that meet the requirements. This phrase may not be used with ACTIVE or DEACTIVE options in the TYPE field of the Query.

(2) Compound Conditional Phrase

The syntax of this phrase is:

<Relational Cond. Phrase> <Log. Oper.> <Relational Cond. Phrase>



or

<Relational Cond. Phrase    Log. Oper.    Status Cond. Phrase>

where Log. Oper. is OR or AND with the meaning of the corresponding logical operators. Note that the Bound Simple Conditional Phrase is not compatible for use in a Compound Conditional Phrase, since it exhibits no boolean value. Also, the Status Conditional Phrase must always appear after the logical operator.

The CONDITION field as a field must be separated by at least one blank from the other fields of the Query. The word FOR, the left parenthesis, and the first element of the conditional phrase do not require separation by blank characters, nor do the last element of the conditional phrase and the right parenthesis.

The CONDITION field is optional and need not appear in the Query. If it is not present, any record is qualified if the MASK field is satisfied. Using the ACTIVATE and DEACTIVATE commands the user can actually have unlimited length conditional phrases, by adding qualified subsets of records in the ACTIVE file.

e. PRINT OPTION field

This is the last field of a Query. It is optional, and if it does not appear the entire record which satisfy both the MASK and the CONDITION fields are printed out.





The elements of the PRINT OPTION field may be any combination of the following:

X, C or S, L, U, D, P, W

with meanings as described in the CONDITION field. The output will include information described in the PRINT OPTION with corresponding headings. The elements of the field can be separated by any number of blanks, by commas, or not at all. If both C and S appear in the PRINT OPTION neither of them is printed out. For the commands ADD and AVERAGE the default PRINT OPTION is X, C or S, D since there is no meaning for LIMITS and PENALTIES.

For all Queries that potentially require more than one output record for the answer (i.e., all Queries except COUNT, ACTIVE, DEACTIVE and SET), the output will include the following entries for each record: NUMBER, NAME, STATUS and the entries specified in the PRINT OPTION field in the sequence in which they appear. At the end of the answer output for each Query the total number of qualified records is given. The heading for the output is determined by the SELECT field. If for this field the option ALL is used, the heading will be the one for ROWS although COLUMNS may also be included in the output.

### 3. The SET Command

By default each time a Command Query is issued the whole solution file is searched starting at the first ROW or



COLUMN and continuing by examining sequentially all the records.

Queries may sometimes apply only to a small part of the solution file or to records whose relative position in the file is known. In these cases the SET command can cause searching to be initiated at a particular entry in the file and continued to another particular entry. Also a fixed step size can be specified for the search. Thus much computational effort can be avoided.

The syntax for the SET Command is:

```
SET <number 1> <number 2> <number 3>
```

where;

number 1 is the number of the starting record

number 2 is the number of the record to stop  
searching

number 3 is the step for searching.

All these numbers must be integers separated by at least one blank and the presence of all of them is required. These numbers also must be in the range of total number of records for the file. The SET limits apply to qualify any subsequent search of the file even if ROW or COLUMN subsets are specified by a Query.

#### EXAMPLE

Suppose the solution file has 300 rows and 2000 columns and the following SET command is issued:



SET 18 1500 10

For all subsequent Queries:

If the SELECT field of the Query is ALL then the searching starts at the 18th record and continues through the 1500th record with step 10 (i.e., Record numbers 18, 28, 38, .... are examined).

If the SELECT field is ROWS then the searching will start at the 18th row through the last row (300th) with step 10.

If the SELECT field is COLUMNS then the searching will start at 18th column through the 1500th column (or equivalently the 318th record through the 1800th record) since the number of columns is greater than 1500.

To restore default settings, use:

'SET DEFAULT' or 'SET D'

### C. ERROR MESSAGES

The following error messages are typed at the terminal as soon as they are detected. If the error is only in syntax, the system is immediately ready to accept a new query, otherwise execution is terminated. Errors have been grouped with one message for each group. Messages are self explanatory.

<u>ERROR NO</u>	<u>POSSIBLE REASON</u>
1	: Attempt to parse a blank query.
101	: Invalid TYPE field. One of the characters D,V,C or blank was expected after A.



102 : Invalid TYPE field. One of the characters  
O,E was expected after S.

103 : Invalid TYPE field. One of the characters  
P,V was expected after NO.

104 : Invalid TYPE field. No command starts  
with the given letter.

201 : Missing character or somewhere in the  
query there is no space delimiter.

202 : There is no space delimiter.

301 : Invalid SELECT field. SELECT field is  
missing or there is no space delimiter  
between TYPE and SELECT fields.

502 : Invalid CONDITION field. the word FOR is  
missing (the string OR was expected after  
F), or invalid PRINT field.

503 : Missing left parenthesis in CONDITION field.

504 : Incomplete condition field or missing  
space delimiter.

505 : Missing right parenthesis in condition field.

506 : Invalid OR logical operator. Character R  
R was expected after O.

507 : Invalid AND logical operator. The string  
ND was expected after A.

508 : Invalid logical operator. Only OR and  
AND are accepted.

511 : Invalid operand for status. The character  
C or S was expected after B.





512 : Invalid operand for status. The character  
L was expected after L.

513 : Invalid operand for status. The character  
L was expected after U.

514 : Invalid operand for status. The character  
Q or R was expected after E.

515 : Invalid operand for status. The character  
V, S, F or B was expected before C.

516 : Invalid operand for status. The character  
V, S, R, F, E or T was expected before R.

517 : Invalid operand for status. The character  
P was expected before P.

518 : Invalid operand for status. The character  
I, A, C or D was expected before E.

519 : Missing space delimiter after status  
operand.

520 : Non recognizable operand for status.

601 : Invalid first operand for relational  
operator in condition field.

602 : Missing space delimiter in a simple  
conditional phrase.

603 : Invalid relational operator. The character  
T or E was expected after G.

604 : Invalid relational operator. The character  
T or E was expected after L.

605 : Invalid relational operator. The character  
Q was expected after E.



606 : Invalid relational operator. The character  
E was expected after N.

607 : Invalid operand in bound conditional  
phrase. The character N was expected  
after string MI.

608 : Invalid operand in bound conditional  
phrase. The string AX was expected after M.

609 : Unrecognizable relational operator in  
simple conditional phrase.

701 : Invalid print field, or missing word FOR  
in condition field.

1001 : Error in input data. Unrecognizable  
status code.

1002 : Error in input data. Data encountered  
has less than the expected number of rows  
and columns.

#### D. LIMITATIONS - EXTENSIONS

As mentioned in the introduction, ATHENA is a direct expansion of the PERUSE system. It includes all the features of PERUSE, except the weighted average command and has the following differences and extensions:

1. ATHENA supports two distinct data structures, each different from that of PERUSE. This was necessary in order to support efficient access to individual records or group of records. The SUPERSPARSE data structure is unique to ATHENA.



2. ATHENA accepts as input a simple file which can be easily obtained from the solution file of any linear programming package on tape, disk or cards.

3. ATHENA supports the commands SET, ACTIVATE, DEACTIVATE and COUNT, in addition to the commands of PERUSE, allowing the user to construct logical subsets of the solution and efficiently access these subsets as independent files with very small access time.

4. ATHENA supports compound conditional phrases for extraction of more specific information and the bound conditional phrase for maximum and minimum values.

5. ATHENA uses object time variable format allowing better appearance of output and uses the words NONE and INFINITY instead of the number 0.7273E76 for better readability.

6. ATHENA accepts reduced problems from PREP [2] and can be used to pass the PREP status file with the solution file of any optimization system to permit recovery of the original problem solution.

ATHENA has been designed to handle solution files with up to 30,000 records. The actual limit is imposed by the number of real number values that must be stored explicitly. This number cannot presently exceed 65536 since this is the largest integer pointer value which can be stored by ATHENA in a 2-byte halfword. Experience has shown that the average number of stored values for each record, excluding penalties



is 1.5 [7]. Adding to this another 0.5 per record for penalties, the problem size limit may be as large as 30,000 rows and columns.

A rough estimation of the space needed for the packed file in 4-byte words can be obtained by multiplying the sum of rows and columns of the solution file by 5 for the SPARSE data structure and by 4 for SUPERSPARSE. Before using ATHENA, adjust the size of the SOLFIL array in common block SOLPAC to this number. To avoid passing problems with common areas under the IBM 360/67 Operating System, use an array size that is an exact multiple of 4096 larger than the number calculated above. Also make corresponding adjustments to the DEFINE FILE statement of the main program. Other computers will require analogous modifications to this array size.

ATHENA has been developed in modular form and can be easily changed or extended to support future needs. Commands which can be easily implemented include the weighted average, the sort of output, or further calculations needed for the analysis of the solution file. ATHENA can also be used as part of an integrated system for sensitivity analysis of optimization problems.

## E. SYSTEM INTERFACE

### 1. Preview

Linear Programming packages give differing forms of output so that it is difficult for a system to be interfaced





with all of these solution formats. ATHENA accepts as input a solution file in a 'standard' form which can be easily obtained from any other solution file form.

ATHENA is best utilized in an interactive system such as CP/CMS, although it can also be used in batch processing. On the other hand, most L.P. packages run only in batch processing. Moreover, in some systems there is no integration of interactive and batch processing (as is currently the case at the Naval Postgraduate School Computer Center). In these cases, the solution files may be transferred manually from one system to the other using magnetic tapes or cards.

A simple input file has been designed which can be punched in cards or entered on tape, disk, or other storage media.

## 2. Input File

The input file consists of records with the following structure:

a. The first record always contains the number of ROWS, the number of COLUMNS, and in position 51 the character '1' if each ROW record contains PENALTIES or '0' otherwise. The FORMAT of the first record is

(I5,30X,I5,10X,I1).

b. Each subsequent record contains explicitly all the information associated with each ROW and COLUMN, with



the following format:

NAME	Format	2A4	(left justified)
STATUS	Format	A2	

X, C or S, L, U, and D numeric field values with Format 5E14.5 or 5F14.5. (The meanings of each of these fields is described in the previous section.) If the solution file includes PENALTIES, then two records will be associated with each ROW. The first will be exactly that described above, and the second will have the FORMAT(E14.5,16X,E14.5) for P, and W, the UPPER and LOWER PENALTIES. In all cases, INFINITE values will be represented explicitly by the number  $\pm 0.1E76$ . The total number of records must agree with the sum of ROWS plus COLUMNS, with the records of ROWS preceeding those of COLUMNS; otherwise an Input error will occur. The file is read in and packed one record at a time.

### 3. Packed File

#### a. Packed File as Input

If the input file is already packed from a previous use of the system, it will be read in unformatted binary format. The system will provide the user information for memory requirements before reading the file. The packed file may be on a tape or disk but cannot be on cards. The system will ask the user at the beginning of a session for the number of the file.

#### b. Packed File as Output

If an unpacked file is used as input, the system will ask for the file number where a packed file is to be



written. Of course, a DEFINE FILE FORTRAN statement must be included right after the declarations of the main program.

#### E. EXAMPLE OF SYSTEM USE

The procedure follows for use of ATHENA at the Naval Postgraduate School Computer Center with the IBM 360/67. The solution file here is produced by the MPS/360 package and ATHENA is used under CP/CMS. Similar procedures can be followed for any other installation.

##### 1. Obtaining the Unpacked Solution

a. Submit the problem to be solved using the usual Control Cards required for the MPS/360 package inserting before the Control Card:

```
//MPS2.SYSIN DD *
```

the following cards:

```
//MPS2.SYSPRINT DD DSN=Sxxxxx.nnnnnnn,  
// UNIT=3330,VOL=SER=DISK04,  
// SPACE=(CYL,(1,1)),DISP=(NEW,KEEP),  
// DCB=(RECFM=UA,BLKSIZE=133)
```

With these cards the output of MPS will go to the DISK instead of the printer.

xxxx is the user's number and

nnnnnn is the file name on the disk.



If the solution file is too big or disk space is not available use tape or tapes to store the output.

b. Use the program REWRITE (page 98) to transform the MPS/360 tape or cards to the format required for the ATHENA unpacked Input file.

c. Now the unpacked file for ATHENA is available and can be used to analyze the solution.

## 2. Using the System Under CP/CMS

ATHENA in CP/CMS TEXT form requires about 67K bytes. The space needed for the packed file depends on the number of records, the method used for packing and the density of the original file. 200K bytes would be sufficient to hold a packed file with up to 13,000 rows and columns. After sufficient space has been secured, the following procedure may be applied:

a. Ask OPERATOR to connect the tape with the Input file created by the REWRITE to the private disk as device 181. As soon as the tape is connected, the message 'DEVICE 181 ATTACHED' will be printed at the terminal.

b. Before using the tape, type ALWAYS under CMS the command ' TAPE SKIP 1 '. This command will position the tape at the first record of the file. This command is required because the tape created by IBM O.S./360.

c. Type \$ ATHENA

ATHENA will ask for information about the file identifiers for input-output, whether the file is packed and method of packing and will give the size of the packed





file. For input file ordinal use any number between 01 and 99 excluding the numbers 03 - 06. For output file ordinal give the number 03 or 04. These are the numbers used by the DEFINE FILE FORTRAN statement and they can be changed. The system will be ready to accept QUERIES as soon as the prompt phrase 'INPUT A COMMAND' is typed by ATHENA at the terminal. The packed file can be saved on a tape using the 'TAPE DUMP' command under CMS.

In the next few pages a demonstration of using ATHENA with a solution file of 766 rows and 10921 columns is given. This problem is a mixed integer optimization model with 963 binary variables for medium term capital budgeting of the Naval Air Test Center [6]. For this problem, a query may require as much as one and a half minutes of clock time if the interactive system on the IBM 360/67 is under heavy yes and the query is difficult to answer. However, most queries are answered almost immediately. Response time is especially good when the user makes use of ACTIVATE, MASK and SET features to qualify necessary searching.



\$ ATHENA

WHAT IS THE FILE NO OF THE SOLUTION FILE ? (FORMAT I2)

04

IS THE FILE ALREADY PACKED ? ENTER YES OR NO :

YES

MEMORY REQUIRMENTS FOR THE PACKED FILE :47749 4-BYTE  
WORDS

IF YOU HAVE SUFFICIENT MEMORY SPACE ENTER YES

OTHERWISE ENTER NO MAKE ADJUSTMENTS AT COMMON AND TRY  
AGAIN  
YES

INPUT A COMMAND

\*\*\*\*\*  
\* USING THE CHARACTER \* AS THE FIRST COLUMN OF THE QUERY \*  
\* THE QUERY IS IGNORED AND THIS IS A CONVENIENT WAY TO \*  
\* INSERT COMMENTS IN THE OUTPUT FROM A TERMINAL, \*  
\* COMMENTS IN THE OUTPUT FROM THE OFFLINE PRINTER ARE \*  
\* INSERTED USING THE LETTER H INSTEAD OF \*. \*  
\* TO AVOID THE PROMPTNESS PHRASE 'INPUT A COMMAND' AT \*  
\* THE OUTPUT USE THE COMMAND 'NOPROMPT'. \*  
\* BECAUSE OF THE REQUIREMENTS FOR THE APPEARANCE OF THE \*  
\* THESIS THE PRINT OPTION FIELD OF THE DISPLAY COMMAND \*  
\* IS USED ONLY WITH AT MOST TWO OPTIONS. \*  
\*\*\*\*\*

\*  
\*  
\* HERE IS A DEMONSTRATION OF USING THE SYSTEM ATHENA.  
\*  
\*

\* HOW MANY ROWS HAS THE FILE ?

\*  
COUNT ROWS \*

766 ROWS OR COLUMNS WITH MASK : \*\*\*\*\*  
SATISFY THE CONDITIONS

\*  
\* HOW MANY COLUMNS ?

\*  
COUNT COLUMNS \*

10921 ROWS OR COLUMNS WITH MASK : \*\*\*\*\*  
SATISFY THE CONDITIONS

\*  
\* HOW MANY OF THEM ARE BASIC ?

\*  
C C \* FOR(ST BS)



506 ROWS OR COLUMNS WITH MASK : \*\*\*\*\*  
SATISFY THE CONDITIONS

\*  
\* HOW MANY OF THEM ARE EQUAL ZERO ?  
\*  
C C \* FOR( X EQ 0. AND ST BS)

55 ROWS OR COLUMNS WITH MASK : \*\*\*\*\*  
SATISFY THE CONDITIONS

\*  
\* USING THE COMMAND 'ACTIVATE' ONLY THE ACTIVATED  
\* RECORDS ARE SEARCHED TO ANSWER THE QUESTION.  
\* THIS IS A GOOD WAY TO AVOID SEARCH OF THE WHOLE  
\* FILE.  
\*  
ACTIVATE COLUMNS XO

73 RECORDS ACTIVATED  
TOTAL RECORDS ACTIVE : 73

\*  
\* HOW MANY ROWS NOW ?  
\*  
C R \*

0 ROWS OR COLUMNS WITH MASK : \*\*\*\*\*  
SATISFY THE CONDITIONS

\*  
\* THERE ARE NO ROWS SINCE ONLY COLUMNS ACTIVATED.  
\* HOW MANY OF THEM ARE BASIC ?  
\*  
C C \* FOR(ST BS)

1 ROWS OR COLUMNS WITH MASK : \*\*\*\*\*  
SATISFY THE CONDITIONS

\*  
\* DISPLAY THEM  
\*

DISPLAY C \* FOR(ST BS) X L  
THE FOLLOWING ROWS OR COLUMNS SATISFY CONDITIONS

NUMBER	.NAME..	AT	...ACTIVITY...	..LOWER LIMIT.
803	X041	BS	0.12910	0.00000

1 ROWS OR COLUMNS WITH MASK : \*\*\*\*\*  
SATISFY THE CONDITIONS

\*  
\* WHAT IS THE AVERAGE OF NONZERO ACTIVITIES ?  
\*  
AVERAGE C \* FOR(X NE 0)  
THE FOLLOWING ROWS OR COLUMNS SATISFY CONDITIONS



NUMBER	.NAME..	AT	...ACTIVITY...	..INPUT COST..
SUMS OR AVERAGES :			0.98773	0.76576

71 ROWS OR COLUMNS WITH MASK : \*\*\*\*\*  
 SATISFY THE CONDITIONS

\*

\* THE SUM OF ACTIVITIES AND INPUT COST ?

\*

ADD C \* FOR ( X NE 0 )

THE FOLLOWING ROWS OR COLUMNS SATISFY CONDITIONS

NUMBER	.NAME..	AT	...ACTIVITY...	..INPUT COST..
SUMS OR AVERAGES :			70.12909	54.36882

71 ROWS OR COLUMNS WITH MASK : \*\*\*\*\*

SATISFY THE CONDITIONS

\*

\* ADD SOME NEW COLUMNS AT THE ACTIVE FILE

\*

ACT C YM01

175 RECORDS ACTIVATED  
 TOTAL RECORDS ACTIVE : 248

\*

\* BASIC ?

\*

C C \* FOR (ST BS)

7 ROWS OR COLUMNS WITH MASK : \*\*\*\*\*  
 SATISFY THE CONDITIONS

\*

\* DISPLAY BASIC AND ZERO ACTIVITY

\*

D C \* FOR ( X EQ 0 AND STATUS BS) X C  
 THE FOLLOWING ROWS OR COLUMNS SATISFY CONDITIONS

NUMBER	.NAME..	AT	...ACTIVITY...	..INPUT COST..
5568	YM01061	BS	0.00000	-0.01000

1 ROWS OR COLUMNS WITH MASK : \*\*\*\*\*  
 SATISFY THE CONDITIONS

\*

\* HOW MANY INPUT COSTS ARE ZERO ?

\*

C C \* FOR( C EQ 0 )





5 ROWS OR COLUMNS WITH MASK : \*\*\*\*\*  
SATISFY THE CONDITIONS

\*  
\* HOW MANY AT LOWER LIMIT ?  
\*  
C C \* FOR(STATUS LL)

171 ROWS OR COLUMNS WITH MASK : \*\*\*\*\*  
SATISFY THE CONDITIONS

\*  
\* ELIMINATE SOME RECORDS FROM THE ACTIVE FILE  
\*  
DEACTIVATE C X

73 RECORDS DEACTIVATED  
TOTAL RECORDS ACTIVE : 175

\*  
\* CHECK FOR THE ELIMINATION  
\*  
C C X

0 ROWS OR COLUMNS WITH MASK : X\*\*\*\*\*  
SATISFY THE CONDITIONS

\*  
\* ELIMINATION O.K.  
\*

\* HOW MANY AT LOWER LIMIT (LL) NOW ?  
\*  
C C \* FOR (ST LL)

169 ROWS OR COLUMNS WITH MASK : \*\*\*\*\*  
SATISFY THE CONDITIONS

\*  
\* WHAT IS THERE AVERAGE ?  
\*

AV C \* FOR(ST LL)  
THE FOLLOWING ROWS OR COLUMNS SATISFY CONDITIONS

NUMBER	.NAME..	AT	...ACTIVITY...	..INPUT COST..
SUMS OR AVERAGES :			0.00000	-0.01000

169 ROWS OR COLUMNS WITH MASK : \*\*\*\*\*  
SATISFY THE CONDITIONS

\*  
\* RETURN TO THE ORIGINAL BIG FILE  
\*  
DEACTIVATE ALL  
F I L E D E A C T I V E



```
*
* DISPLAY THE 5 FIRST ROWS
*
```

```
SET 1 5 1
D R * X S
THE FOLLOWING ROWS OR COLUMNS SATISFY CONDITIONS
```

NUMBER	.NAME..	AT	...ACTIVITY...	SLACK ACTIVITY
1	BENEFITS	BS	449.49902	-449.49902
2	RC1011	UL	0.00000	0.00000
3	RC1021	UL	0.00000	0.00000
4	RC1031	UL	0.00000	0.00000
5	RC1041	BS	0.00000	0.00000

```
5 ROWS OR COLUMNS WITH MASK : *****
SATISFY THE CONDITIONS
```

```
*
* THE FIRST 5 COLUMNS
*
```

```
D C * C D
THE FOLLOWING ROWS OR COLUMNS SATISFY CONDITIONS
```

NUMBER	.NAME..	AT	..INPUT COST..	.REDUCED COST.
767	X001	UL	0.99994	0.36312
768	X002	UL	0.89108	0.77450
769	X003	UL	0.45629	0.23338
770	X004	UL	0.45483	0.36919
771	X005	UL	0.73440	0.60813

```
5 ROWS OR COLUMNS WITH MASK : *****
SATISFY THE CONDITIONS
```

```
*
* RETURN TO THE ORIGINAL FILE
*
```

```
SET DEFAULT
```

```
*
* DISPLAY VARIABLES IN A SPECIFIC RANGE
*
```

```
D C YM FOR (X GT 10.5 AND X LT 25.5) X L
THE FOLLOWING ROWS OR COLUMNS SATISFY CONDITIONS
```

NUMBER	.NAME..	AT	...ACTIVITY...	..LOWER LIMIT.
5708	YM05061	BS	14.00000	0.00000
6139	YM17171	BS	11.54310	0.00000
6247	YM20201	BS	17.13029	0.00000
6758	YM35061	BS	17.29999	0.00000
7472	YM20202	BS	18.98279	0.00000
7983	YM35062	BS	11.90000	0.00000
8697	YM20203	BS	21.00000	0.00000
9208	YM35063	BS	16.59999	0.00000
9378	YM05014	BS	11.90000	0.00000
9922	YM20204	BS	13.00000	0.00000
10433	YM35064	BS	23.06062	0.00000
10608	YM05065	BS	14.00000	0.00000
11147	YM20205	BS	13.00000	0.00000
11658	YM35065	BS	19.50000	0.00000



14 ROWS OR COLUMNS WITH MASK : YM\*\*\*\*\*  
SATISFY THE CONDITIONS

\*  
\* WHAT IS THE MAXIMUM OF THE ACTIVITY LEVEL ?  
\*

D C \* FOR(X MAX) X C  
1 YM18184 BS 88.63869 0.00000

1 ROWS OR COLUMNS WITH MASK : \*\*\*\*\*  
SATISFY THE CONDITIONS

\*  
\* THE MINIMUM LOWER LIMIT FOR THE ROWS ?  
\*

D R \* FOR(L MIN) L U  
766 BENEFITS BS NONE NONE

766 ROWS OR COLUMNS WITH MASK : \*\*\*\*\*  
SATISFY THE CONDITIONS

\*  
\* THE MAXIMUM ACTIVITY LEVEL FROM VARIABLES  
\* STARTING WITH LETTER Y ?  
\*

D C Y FOR ( X MAX ) XC  
1 YM18184 BS 88.63869 0.00000

1 ROWS OR COLUMNS WITH MASK : Y\*\*\*\*\*  
SATISFY THE CONDITIONS

\*  
\* ARE THERE INFEASIBILITIES ?  
\*

COUNT ALL \* FOR (ST IN)

0 ROWS OR COLUMNS WITH MASK : \*\*\*\*\*

SATISFY THE CONDITIONS

\*  
\* EXIT FROM THE SYSTEM  
\*

END



## APPENDIX

The whole program consists of 3 main parts: The input part, the parser-code generation part and the interpreter part (see Figure 1). The main program calls these 3 parts according to the instructions from the user. More detailed information for the main subroutines of each part are given below.

### 1. Input Part.

There are 2 almost identical subroutines named READF and READD. READF is used to pack the solution file in SPARSE data structure and READD in SUPERSPARSE.

#### a. Input Parameters

(1) IFLR: The file number of the solution file. This can be any number between 1 - 99 excluding the numbers 3, 4, 5, and 6.

(2) IFLW: The file number where the packed file will be written. Currently this number can be 3 or 4 since the DEFINE FILE statement in the main program defines the files 3 and 4 only.

#### b. Output Parameters

(1) NROWS, NCOL; The number of rows and columns of the solution file respectively.

(2) IER: If this value is different from zero an error has been encountered in the input data.





The solution file is read in standard format, as explained in user's manual, one record at a time, filling the array SOLFIL in the common area SOLPAC with the packed file. The name of the record is read directly into SOLFIL and the associated values into the array DATA. The 2 character status code is read into the INTEGER\*2 variable STAT. The INTEGER\*2 array CSTAT has all possible values for status, and their location in this array, minus one, gives the corresponding value of the first bit group in the 16 bit map as explained in the data structure section.

The variable INDEX always points to the next available location for storing the next nonzero, noninfinite number. The value of INDEX at the beginning of the processing of each record is stored in the 2-byte pointer after the name. Each number in the array DATA is examined and if it is eligible for storage it is stored at the location SOLFIL(INDEX) and INDEX is increased by one. At this point, for the subroutine READD, the end of the array SOLFIL, where the distinct real number values are stored, is searched and if the value sought is found the location of this value, counting from the end of the array is stored at the location SOLFIL(INDEX); otherwise, a new entry is made and the location of this entry is stored at the location SOLFIL(INDEX). Notice that SOLFIL(INDEX) is a 4-byte location for READF but 2-byte for READD as explained earlier. After the last record has been packed, READD shifts the distinct real number values



down to the end of 2-byte indirect pointers. When the system is to be used under batch processing the CALL TAPSET statement from READF and READD must be removed and the input file must be described using the usual DD statement.

## 2. Parser - Code Generator

There are several subroutines in this part of the system. There is one subroutine for each field of the query, the control subroutine PARSE and various others to perform specific tasks like getting the numerical value of a string of decimal characters, etc. The subroutine PARSE is described below. The numerical codes used for each case have been inserted as comments at the beginning of each subroutine where they are used.

### a. Input Parameters

(1) QRY: INTEGER\*2 array with the query to be parsed in A format.

### b. Output Parameters

(1) CODE: INTEGER\*2 array with the numerical code for query as follows:

QRY(1)	: TYPE	field
QRY(2)	: SELECT	field
QRY(3)	: MASK	field
QRY(4) - QRY(10)	: CONDITION	field
QRY(11) - QRY(18)	: PRINT	field

(2) MASK: INTEGER\*2 array with the mask from the query, one character per location.



(3) ARG2, ARG4 : numerical values from the condition field, if any.

(4) IER : Code number for syntax error. If IER=0 the query has been parsed correctly.

Subroutine PARSE calls sequentially the corresponding subroutines to parse each field of the query. Before calling it positions the pointer ICOLL at the location of the QRY where the field starts using the subroutine GETNCH.

### 3. Interpreter Part

There are several subroutines called by the main subroutine INTERP of this part.

#### a. Input Parameters

(1) CODE, MASK, ARG2, ARG4, NROWS, NCOL, IER as described previously.

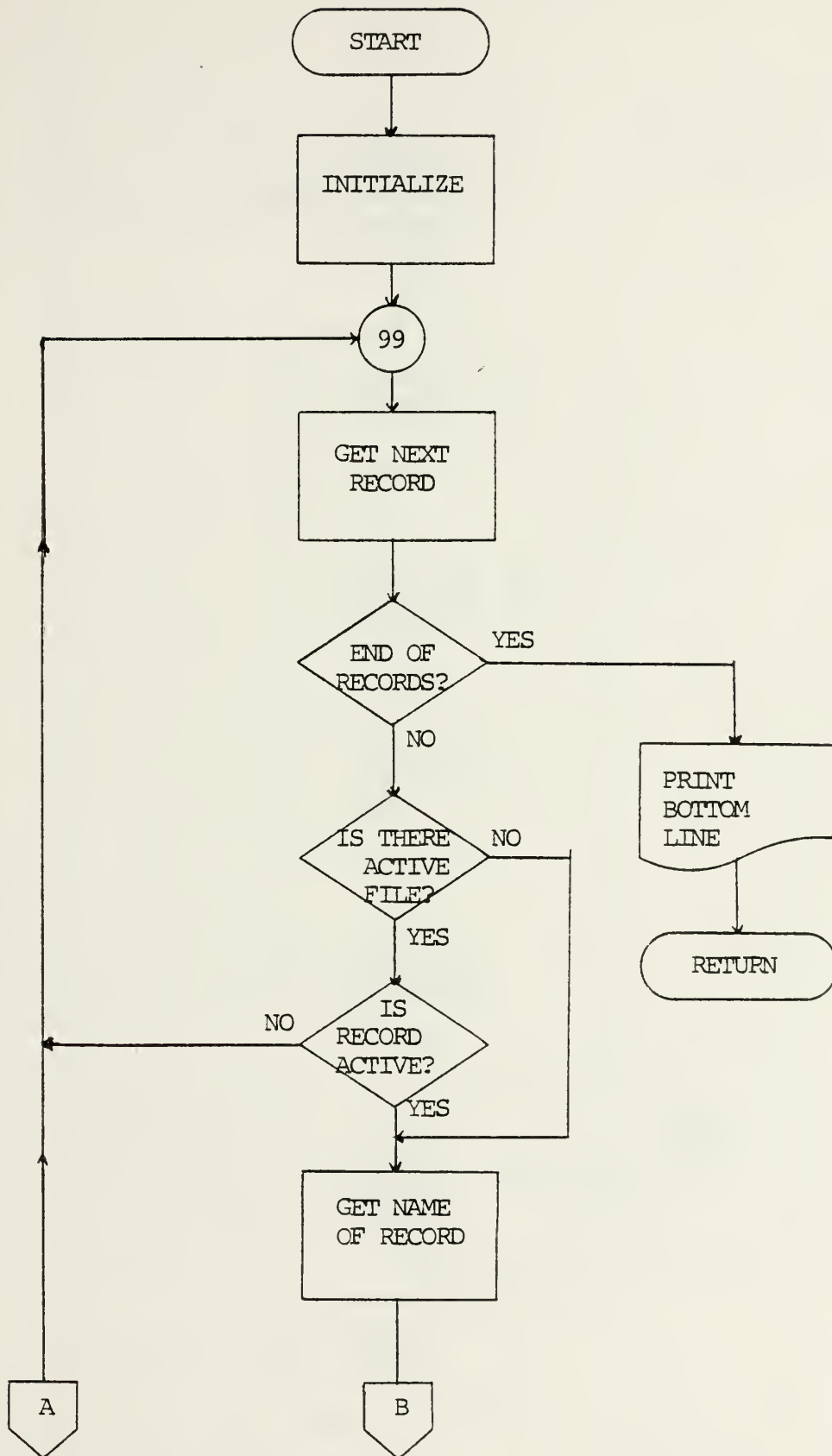
(2) K1, K2, K3 : Record number to start searching, to stop searching and searching step respectively. Default values are 1, (NROWS + NCOL), 1.

(3) IFLG : Flag to determine the data structure type of the packed file. If IFLG=0, data structure SPARSE otherwise SUPERSPARSE.

(4) IACT : Passed through the INIT common area and, if 0, the searching is done as determined by K1, K2, K3, otherwise there is an active file created by the user through the ACTIVATE command and only the members of this file are searched.

The logic of this subroutine is shown in the flowchart on the next two pages.

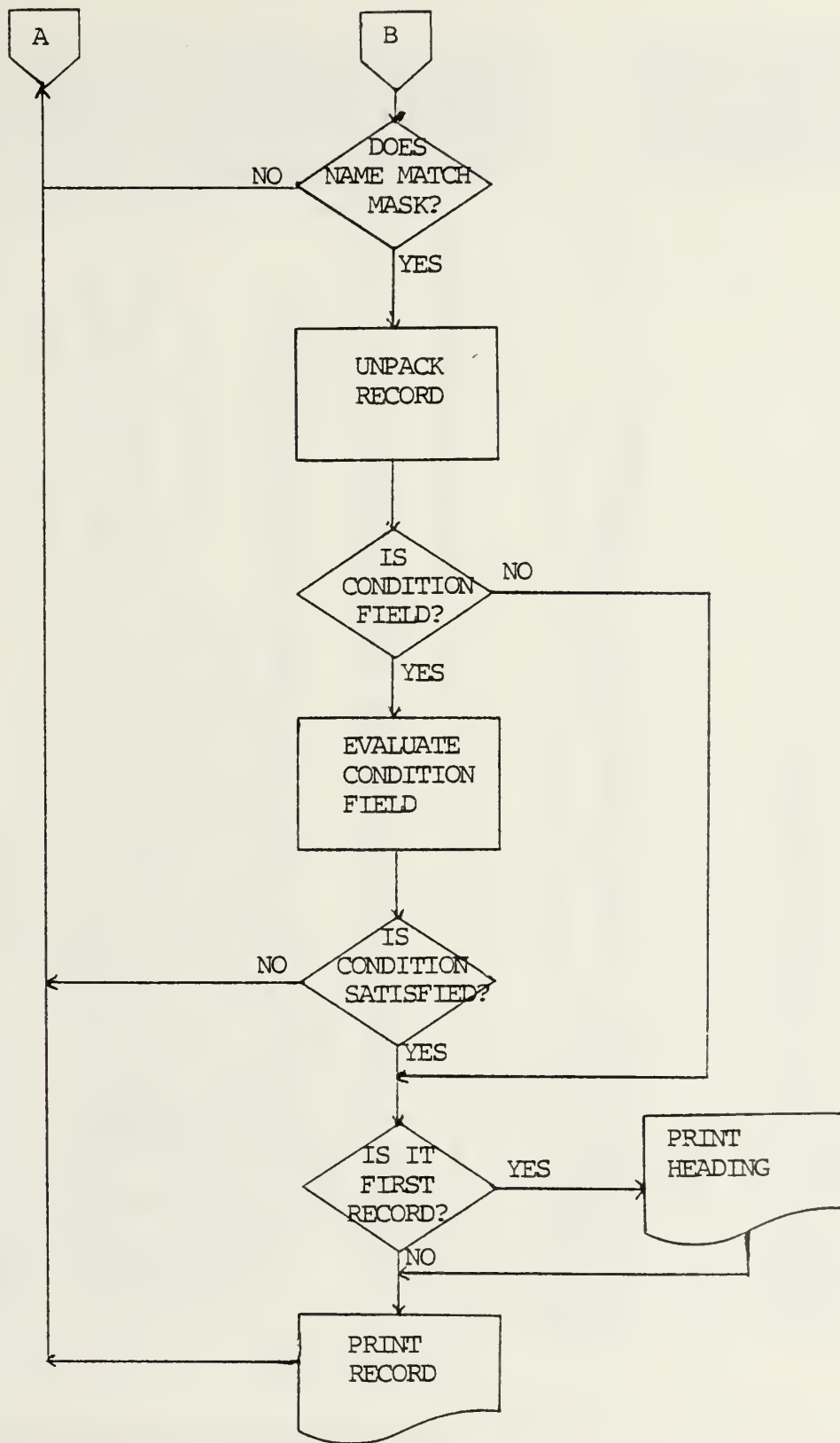




INTERPRETER













```

C GET INFORMATION NEEDED FOR THE SOLUTION FILE
C
C
11004 WRITE(6,1004)
      FCRMAT(2X,'WHAT IS THE FILE NO OF THE SOLUTION FILE ? (FORMAT I2)')
- )
11005 READ(5,1005) IFLR
      FCRMAT(I2)
      WRITE(6,1001)
11001 FCRMAT(2X,'IS THE FILE ALREADY PACKED ? ENTER YES OR NO :')
      READ(5,1002) KI
11002 FCRMAT(A4)
      IF(KI.NE.KK) GO TO 1099
      WRITE(6,1003)
11003 FCRMAT(2X,'FOR BETTER MEMORY UTILIZATION ANSWER YES OR NO TO THE
      FOLLOWING QUESTION :',//,IX,'DO YOU EXPECT THE DISTINCT VALUES OF
      THE SOLUTION FILE TO BE LESS THAN HALF OF THOSE NUMBERS EXCLUDING
      ZEROES AND INFINITY ? :')
      READ(5,1002) KI
      WRITE(6,1007)
11007 FCRMAT(5X,'WHAT IS THE FILE NO YOU WANT THE PACKED FILE TO BE WRIT
      TEN ? (FORMAT I2)')
      READ(5,1005) IFLW"
      WRITE(6,1006)
11006 FCRMAT(10X,'READING AND PACKING THE SOLUTION FILE')
C
C
C      READING AND PACKING THE SOLUTION FILE
      IF(KI.EQ.KK) CALL READF(NROWS,NCOL,IER,IFLR,IFLW)
      IF(KI.NE.KK) CALL READD(NROWS,NCOL,IER,IFLR,IFLW)
C
C

```



MAI00840  
MAI00850  
MAI00860  
MAI00870  
MAI00880  
MAI00890  
MAI00900  
MAI00910  
MAI00920  
MAI00930  
MAI00940  
MAI00950  
MAI00960  
MAI00970  
MAI00980  
MAI00990  
MAI01000  
MAI01010  
MAI01020  
MAI01030  
MAI01040  
MAI01050  
MAI01060  
MAI01070  
MAI01080  
MAI01090  
MAI01100  
MAI01110  
MAI01120  
MAI01130  
MAI01140  
MAI01150  
MAI01160  
MAI01170  
MAI01180  
MAI01190  
MAI01200  
MAI01210  
MAI01220  
MAI01230  
MAI01240  
MAI01250  
MAI01260  
MAI01270  
MAI01280  
MAI01290  
MAI01300  
MAI01310

```

1099 IF( IER.NE.0) GO TO 999
      GO TO 1020
      CONTINUE
      READ(IFLR,1) (SOLFIL(IK),IK=1,100)
      IK=SOLFIL(1)
      WRITE(6,1066) IK
1066 -WORDS, //,3X, 'MEMORY REQUIREMENTS FOR THE PACKED FILE:',15,' 4-BYTE
      - MAKE ANDJUSTMENTS AT COMMON AND TRY AGAIN')
      READ(5,1002) K1
1020 IF(K1.EQ.KK) GO TO 99
      READ(IFLR,1) (SOLFIL(IL),IL=1,IK)
      NROWS=SOLFIL(3)
      NCOL=SOLFIL(4)
      ISIZE=SOLFIL(1)
      IFLG=SOLFIL(2)

C      INITIALIZE FLAGS - CALCULATE LIMITS
C
C
C
92  IER=0
      VER=.FALSE.
      PROM=.TRUE.
      HEAD=.FALSE.
      K1=1
      K2=NROWS+NCOL
      K3=1
10  CONTINUE
      DO 2 J=1,18
2   CODE(J)=0
      CALL TIMER
100 IF(PROM) WRITE(6,100)
      FORMAT(15X,' INPUT A COMMAND ')
C   READ THE QUERY
C
C   READ(5,200) QRY
C
C   CHECK IF IT IS HEADING
C
      IF(QRY(1).EQ.H) GO TO 61
      IF(VER) WRITE(6,300) QRY
      FORMAT(80A1)
200 C
C   CALL THE PARSER TO PARSE THE QUERY
C
      CALL PARSE(QRY,CODE,MASK,ARG2,ARG4,ICOL1,IER)

```





C	IF (IER.NE.0) GO TO 999	MAI01320
C		MAI01330
C	CHECK WHAT KIND OF QUERY IS IT	MAI01340
C	IF IT IS CONTROL PROCESS IT HERE OTHERWISE CALL INTERPRETER	MAI01350
C		MAI01360
C		MAI01370
		MAI01380
		MAI01390
		MAI01400
		MAI01410
		MAI01420
		MAI01430
30	IF (CODE(1).GT.10) GO TO 20	MAI01440
	IF (CODE(1).EQ.10) GO TO 10	MAI01450
	IF (CODE(1).NE.1) GO TO 30	MAI01460
	VER=.TRUE.	MAI01470
	GO TO 10	MAI01480
	IF (CODE(1).NE.2) GO TO 40	MAI01490
	VER=.FALSE.	MAI01500
	GO TO 10	MAI01510
40	IF (CODE(1).NE.3) GO TO 50	MAI01520
	PROM=.TRUE.	MAI01530
	GO TO 10	MAI01540
	IF (CODE(1).NE.4) GO TO 60	MAI01550
50	PROM=.FALSE.	MAI01560
	GO TO 10	MAI01570
	IF (CODE(1).NE.5) GO TO 70	MAI01580
60	QRY(1)=BLANK	MAI01590
61	WRITE(6,300) QRY	MAI01600
300	FORMAT(IX,80A1)	MAI01610
	GO TO 10	MAI01620
70	IF (CODE(1).EQ.6) GO TO 99	MAI01630
	IF (CODE(1).NE.7) GO TO 80	MAI01640
	CALL GETNCH(QRY,ICOL1,BLANK,IER)	MAI01650
	IF (IER.NE.0) GO TO 999	MAI01660
	IF (QRY(ICOL1).EQ.D) GO TO 92	MAI01670
	MET=0	MAI01680
	MET=MET+1	MAI01690
90	DO 1 J=ICOL1,80	MAI01700
	ITEMP=J	MAI01710
	IF (QRY(J).EQ.BLANK) GO TO 91	MAI01720
1	CONTINUE	MAI01730
91	IF (MET.GT.3) GO TO 10	MAI01740
	ITEMP=ITEMP-1	MAI01750
	IF (MET.EQ.1) K1=VAL(QRY,ICOL1,ITEMP)	MAI01760
	IF (MET.EQ.2) K2=VAL(QRY,ICOL1,ITEMP)	MAI01770
	IF (MET.EQ.3) K3=VAL(QRY,ICOL1,ITEMP)	MAI01780
	IF (K2.GT.(NROWS+NCOL)) K2=NROWS+NCOL	MAI01790
	ICOL1=ITEMP	
	CALL GETNCH(QRY,ICOL1,BLANK,IER)	
	GO TO 90	
80	IER=1	
	GO TO 999	







C	IF	COMMENTS	IGNORE THE	QUERY	PAR000210
C					PAR000220
C					PAR000230
		IF(QRY(1)).NE.STAR) GO TO 10			PAR000240
		CODE(1)=10			PAR000250
		RETURN			PAR000260
10		DO 1 J=1,80			PAR000270
		IF(QRY(J).EC.BLANK) GO TO 1			PAR000280
		ICOL1=J			PAR000290
		GC TO 20			PAR00300
1		CNTINUE			PAR00310
		IER=1			PAR00320
		RETURN			PAR00330
C	PROCESS	THE	TYPE	FIELD OF THE	PAR00340
C				COMMAND	PAR00350
C					PAR00360
20		CALL TYPE(QRY,ICOL1,CODE,IER)			PAR00370
		IF(IER.NE.0) RETURN			PAR00380
C	IF	CONTROL	TYPE	COMMAND	PAR00390
C		THE	REMAINING	FIELDS.	PAR00400
C			RETURN	OTHERWISE	PAR00410
				EXAMINE	PAR00420
					PAR00430
		IF(CODE(1).LT.10) RETURN			PAR00440
		CALL GETNCH(QRY,ICOL1,BLANK,IER)			PAR00450
		IF(IER.NE.0) RETURN			PAR00460
		CALL QJAL(QRY,ICOL1,CODE,IER)			PAR00470
		IF(IER.NE.0) RETURN			PAR00480
		CALL GETNCH(QRY,ICOL1,BLANK,IER)			PAR00490
		IF(IER.NE.0.AND.CODE(1).NE.17.AND.CODE(2).NE.1) RETURN			PAR00500
		IF(IER.EQ.0) GO TO 21			PAR00510
		IER=0			PAR00520
		RETURN			PAR00530
21		CALL MASKA(QRY,ICOL1,CODE,MASK,STAR,BLANK,IER)			PAR00540
		IF(IER.NE.0) RETURN			PAR00550
		CALL GETNCH(QRY,ICOL1,BLANK,IER)			PAR00560
		IF(IER.EQ.0) GO TO 30			PAR00570
		IF(IER.EQ.201) IER=0			PAR00580
		RETURN			PAR00590
30		CALL COND(QRY,ICOL1,CODE,ARG2,ARG4,IER)			PAR00600
		IF(IER.EQ.501) GO TO 40			PAR00610
		IF(IER.NE.0) RETURN			PAR00620
		CALL GETNCH(QRY,ICOL1,BLANK,IER)			PAR00630
		IF(IER.EQ.0) GO TO 40			PAR00640
		IF(IER.EQ.201) IER=0			PAR00650
		RETURN			PAR00660
40		CALL PRINT(QRY,ICOL1,CODE,IER)			PAR00670
		RETURN			PAR00680
		END			



CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC

```
*****
**      SUBROUTINE TYPE PARSES THE TYPE FIELD OF THE COMMAND
**      INTERNAL      CODES
**      -----
**      V-ERIFY      : 1
**      NOV-ERIFY    : 2
**      P-ROMPT      : 3
**      NOP-ROMPT    : 4
**      H-EADING     : 5
**      E-END        : 6
**      SET          : 7
**
**      D-ISPLAY     : 11
**      COUNT        : 12
**      A-DD         : 13
**      AV-ERAGE     : 14
**      -ORT         : 15
**      AC-TIVATE    : 16
**      DE-ACTIVATE  : 17
**
*****
**      SUBROUTINE TYPE(QRY,ICOLL,CODE,IER)
**      INTEGER*2 QRY(80),CODE(20)
**      COMMON /CHAR/A,B,C,D,E,F,G,H,I,L,M,N,O,P,Q,R,S,T,U,V,W,X,
**      -BLANK,COMMA,STAR,LPAR,RPAR
**      INTEGER*2 A,B,C,D,E,F,G,H,I,L,M,N,O,P,Q,R,S,T,U,V,W,X,
**      -BLANK,COMMA,STAR,LPAR,RPAR
**      IER=0
**      IF(QRY(ICOLL).NE.D) GO TO 10
**      CODE(1)=11
**      IF(QRY(ICOLL+1).EQ.E) CODE(1)=17
**      RETURN
**      IF(QRY(ICOLL).NE.C) GO TO 20
**      CODE(1)=12
**      RETURN
**      IF(QRY(ICOLL).NE.A) GO TO 30
**      IF(QRY(ICOLL+1).NE.V) GO TO 25
**      CODE(1)=14
**      RETURN
**      CODE(1)=13
**      IF(QRY(ICOLL+1).EQ.D.OR.QRY(ICOLL+1).EQ.BLANK) RETURN
**      CODE(1)=16
**      IF(QRY(ICOLL+1).EQ.C) RETURN
*****
PAR00690
PAR00700
PAR00710
PAR00720
PAR00730
PAR00740
PAR00750
PAR00760
PAR00770
PAR00780
PAR00790
PAR00800
PAR00810
PAR00820
PAR00830
PAR00840
PAR00850
PAR00860
PAR00870
PAR00880
PAR00890
PAR00900
PAR00910
PAR00920
PAR00930
PAR00940
PAR00950
PAR00960
PAR00970
PAR00980
PAR00990
PAR01000
PAR01010
PAR01020
PAR01030
PAR01040
PAR01050
PAR01060
PAR01070
PAR01080
PAR01090
PAR01100
PAR01110
PAR01120
PAR01130
PAR01140
PAR01150
PAR01160
```

10

20

25





```

30  IER=101
    RETURN
    IF(QRY(ICOL1).NE.S) GO TO 40
    CODE(1)=15
    IF(QRY(ICOL1+1).EQ.O.OR.QRY(ICOL1+1).EQ.BLANK) RETURN
    CODE(1)=7
    IF(QRY(ICOL1+1).EQ.E.AND.QRY(ICOL1+2).EQ.T) RETURN
    IER=102
    RETURN
40  IF(QRY(ICOL1).NE.V) GO TO 50
    CODE(1)=1
    RETURN
50  IF(QRY(ICOL1).NE.P) GO TO 60
    CODE(1)=3
    RETURN
60  IF(QRY(ICOL1).NE.H) GO TO 70
    CODE(1)=5
    RETURN
70  IF(QRY(ICOL1).NE.N.AND.QRY(ICOL1+1).NE.O) GO TO 80
    CODE(1)=2
    IF(QRY(ICOL1+2).EQ.V) RETURN
    CODE(1)=4
    IF(QRY(ICOL1+2).EQ.P) RETURN
    IER=103
    RETURN
80  CODE(1)=6
    IF(QRY(ICOL1).EQ.E) RETURN
    IER=104
    RETURN
    END

*****
**  SUBROUTINE  QUAL  PARSES  THE  QUALIFIED  FIELD
**  INTERNAL  CODES
**  -----
**  A-LL          : 1
**  C-COLUMNS    : 2
**  R-ROWS        : 3
**  *****
**
*****
**  SUBROUTINE  QUAL(QRY,ICOL1,CODE,IER)
**  INTEGER*2  QRY(80),CODE(20)
**  COMMON /CHAR/A,B,C,D,E,F,G,H,I,L,M,N,O,P,Q,R,S,T,U,V,W,X,
**  -BLANK,COMMA,STAR,LPAR,RPAR

```



```

INTEG2 A,B,C,D,E,F,G,H,I,L,M,N,O,P,Q,R,S,T,U,V,W,X,
-BLANK,COMMA,STAR,LPAR,RPAR
IER=0
IF(QRY(ICOL1).NE.A) GO TO 10
CCDE(2)=1
RETURN
IF(QRY(ICOL1).NE.C) GO TO 20
CODE(2)=2
RETURN
IF(QRY(ICOL1).NE.R) IER=301
CCDE(2)=3
RETURN
END

```

10

20

CCCCCCCCCCCC

```

*****
* SUBROUTINE MASKA PROCESS THE MASK FIELD OF THE COMMAND
*
*-----
*      MASK ALL      *      : 1
*      MASK NOT ALL  *      : 2
*      MASK WITHOUT ANY *      : 3
*
*-----
*****

```

```

SUBROUTINE MASKA(QRY,ICOL1,CODE,MASK,STAR,BLANK,IER)
INTEG2 QRY(1),CODE(1),MASK(1),STAR,BLANK
IFLAG1=0
IFLAG2=0
DO 1 I=1,8
  MASK(I)=STAR
  IF(IFLAG1.NE.0) GO TO 1
  IF(QRY(ICOL1+I-1).NE.BLANK) GO TO 10
  IFLAG1=1
  GO TO 1
  IF(QRY(ICOL1+I-1).NE.STAR) IFLAG2=IFLAG2+1
  MASK(I)=QRY(ICOL1+I-1)
  CCNTINUE
  CODE(3)=2
  IF(IFLAG2.EQ.0) CODE(3)=1
  IF(IFLAG2.EQ.8) CODE(3)=3
  RETURN
END

```

10

1

CCCC

```

*****

```

PAR01650  
PAR01660  
PAR01670  
PAR01680  
PAR01690  
PAR01700  
PAR01710  
PAR01720  
PAR01730  
PAR01740  
PAR01750  
PAR01760  
PAR01770  
PAR01780  
PAR01790  
PAR01800  
PAR01810  
PAR01820  
PAR01830  
PAR01840  
PAR01850  
PAR01860  
PAR01870  
PAR01880  
PAR01890  
PAR01900  
PAR01910  
PAR01920  
PAR01930  
PAR01940  
PAR01950  
PAR01960  
PAR01970  
PAR01980  
PAR01990  
PAR02000  
PAR02010  
PAR02020  
PAR02030  
PAR02040  
PAR02050  
PAR02060  
PAR02070  
PAR02080  
PAR02090  
PAR02100  
PAR02110  
PAR02120



1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12. 13. 14. 15. 16. 17. 18. 19. 20. 21. 22. 23. 24. 25. 26. 27. 28. 29. 30. 31. 32. 33. 34. 35. 36. 37. 38. 39. 40. 41. 42. 43. 44. 45. 46. 47. 48. 49. 50. 51. 52. 53. 54. 55. 56. 57. 58. 59. 60. 61. 62. 63. 64. 65. 66. 67. 68. 69. 70. 71. 72. 73. 74. 75. 76. 77. 78. 79. 80. 81. 82. 83. 84. 85. 86. 87. 88. 89. 90. 91. 92. 93. 94. 95. 96. 97. 98. 99. 100. 101. 102. 103. 104. 105. 106. 107. 108. 109. 110. 111. 112. 113. 114. 115. 116. 117. 118. 119. 120. 121. 122. 123. 124. 125. 126. 127. 128. 129. 130. 131. 132. 133. 134. 135. 136. 137. 138. 139. 140. 141. 142. 143. 144. 145. 146. 147. 148. 149. 150. 151. 152. 153. 154. 155. 156. 157. 158. 159. 160. 161. 162. 163. 164. 165. 166. 167. 168. 169. 170. 171. 172. 173. 174. 175. 176. 177. 178. 179. 180. 181. 182. 183. 184. 185. 186. 187. 188. 189. 190. 191. 192. 193. 194. 195. 196. 197. 198. 199. 200. 201. 202. 203. 204. 205. 206. 207. 208. 209. 210. 211. 212. 213. 214. 215. 216. 217. 218. 219. 220. 221. 222. 223. 224. 225. 226. 227. 228. 229. 230. 231. 232. 233. 234. 235. 236. 237. 238. 239. 240. 241. 242. 243. 244. 245. 246. 247. 248. 249. 250. 251. 252. 253. 254. 255. 256. 257. 258. 259. 260. 261. 262. 263. 264. 265. 266. 267. 268. 269. 270. 271. 272. 273. 274. 275. 276. 277. 278. 279. 280. 281. 282. 283. 284. 285. 286. 287. 288. 289. 290. 291. 292. 293. 294. 295. 296. 297. 298. 299. 300. 301. 302. 303. 304. 305. 306. 307. 308. 309. 310. 311. 312. 313. 314. 315. 316. 317. 318. 319. 320. 321. 322. 323. 324. 325. 326. 327. 328. 329. 330. 331. 332. 333. 334. 335. 336. 337. 338. 339. 340. 341. 342. 343. 344. 345. 346. 347. 348. 349. 350. 351. 352. 353. 354. 355. 356. 357. 358. 359. 360. 361. 362. 363. 364. 365. 366. 367. 368. 369. 370. 371. 372. 373. 374. 375. 376. 377. 378. 379. 380. 381. 382. 383. 384. 385. 386. 387. 388. 389. 390. 391. 392. 393. 394. 395. 396. 397. 398. 399. 400. 401. 402. 403. 404. 405. 406. 407. 408. 409. 410. 411. 412. 413. 414. 415. 416. 417. 418. 419. 420. 421. 422. 423. 424. 425. 426. 427. 428. 429. 430. 431. 432. 433. 434. 435. 436. 437. 438. 439. 440. 441. 442. 443. 444. 445. 446. 447. 448. 449. 450. 451. 452. 453. 454. 455. 456. 457. 458. 459. 460. 461. 462. 463. 464. 465. 466. 467. 468. 469. 470. 471. 472. 473. 474. 475. 476. 477. 478. 479. 480. 481. 482. 483. 484. 485. 486. 487. 488. 489. 490. 491. 492. 493. 494. 495. 496. 497. 498. 499. 500. 501. 502. 503. 504. 505. 506. 507. 508. 509. 510. 511. 512. 513. 514. 515. 516. 517. 518. 519. 520. 521. 522. 523. 524. 525. 526. 527. 528. 529. 530. 531. 532. 533. 534. 535. 536. 537. 538. 539. 540. 541. 542. 543. 544. 545. 546. 547. 548. 549. 550. 551. 552. 553. 554. 555. 556. 557. 558. 559. 560. 561. 562. 563. 564. 565. 566. 567. 568. 569. 570. 571. 572. 573. 574. 575. 576. 577. 578. 579. 580. 581. 582. 583. 584. 585. 586. 587. 588. 589. 590. 591. 592. 593. 594. 595. 596. 597. 598. 599. 600. 601. 602. 603. 604. 605. 606. 607. 608. 609. 610. 611. 612. 613. 614. 615. 616. 617. 618. 619. 620. 621. 622. 623. 624. 625. 626. 627. 628. 629. 630. 631. 632. 633. 634. 635. 636. 637. 638. 639. 640. 641. 642. 643. 644. 645. 646. 647. 648. 649. 650. 651. 652. 653. 654. 655. 656. 657. 658. 659. 660. 661. 662. 663. 664. 665. 666. 667. 668. 669. 670. 671. 672. 673. 674. 675. 676. 677. 678. 679. 680. 681. 682. 683. 684. 685. 686. 687. 688. 689. 690. 691. 692. 693. 694. 695. 696. 697. 698. 699. 700. 701. 702. 703. 704. 705. 706. 707. 708. 709. 710. 711. 712. 713. 714. 715. 716. 717. 718. 719. 720. 721. 722. 723. 724. 725. 726. 727. 728. 729. 730. 731. 732. 733. 734. 735. 736. 737. 738. 739. 740. 741. 742. 743. 744. 745. 746. 747. 748. 749. 750. 751. 752. 753. 754. 755. 756. 757. 758. 759. 760. 761. 762. 763. 764. 765. 766. 767. 768. 769. 770. 771. 772. 773. 774. 775. 776. 777. 778. 779. 780. 781. 782. 783. 784. 785. 786. 787. 788. 789. 790. 791. 792. 793. 794. 795. 796. 797. 798. 799. 800. 801. 802. 803. 804. 805. 806. 807. 808. 809. 810. 811. 812. 813. 814. 815. 816. 817. 818. 819. 820. 821. 822. 823. 824. 825. 826. 827. 828. 829. 830. 831. 832. 833. 834. 835. 836. 837. 838. 839. 840.

SUBROUTINE COND PARSES THE CONDITION FIELD OF THE QUERY AND GENERATES THE CORRESPONDING CODE.  
THERE ARE 3 KINDS OF SIMPLE CONDITIONAL PHRASES :  
1. <ARG1> <RELOP> <ARG2>  
INTERNAL CODES

|         | ARG1 | RELOP |
|---------|------|-------|
| X       | 1    | EQ    |
| S, OR C | 2    | NE    |
| L       | 3    | GT    |
| U       | 4    | GE    |
| D       | 5    | LE    |
| P       | 6    |       |
| W       | 7    |       |

```

A. AS ARG1
B. ANY REAL OR INTEGER NUMBER
2. <ARG1> <M IN> OR <ARG1> <MAX>
INTERNAL CODES
ARG2 -----

```

```

MIN. : 7
MAX. : 8
STATUS <ARG> OR ST <ARG>
INTERNAL CODES
-----
STATUS OR ST : 9
ARG

```

|     |    |    |    |    |
|-----|----|----|----|----|
| INS | 00 | FC | TR | 14 |
| LL  | 01 | BC | PP | 15 |
| UL  | 02 | VR | EE | 16 |
| EQ  | 03 | SR | IE | 17 |
| V   | 04 | RR | CE | 18 |
| VC  | 05 | ER | DE | 19 |
| S   | 06 |    |    |    |

THERE ARE 2 KINDS OF COMPOUNT CONDITIONAL PHRASES :  
 1. <1ST SIMP> <RELOP> <1ST SIMP>  
 2. <1ST SIMP> <RELOP> <2ND SIMP>  
 INTERNAL CODES

OR : 1  
AND : 2  
FOR MORE DETAILS SEE USER'S MANUAL

|    |          |
|----|----------|
| ** | PAR02130 |
| ** | PAR02140 |
| ** | PAR02150 |
| ** | PAR02160 |
| ** | PAR02170 |
| ** | PAR02180 |
| ** | PAR02190 |
| ** | PAR02200 |
| ** | PAR02210 |
| ** | PAR02220 |
| ** | PAR02230 |
| ** | PAR02240 |
| ** | PAR02250 |
| ** | PAR02260 |
| ** | PAR02270 |
| ** | PAR02280 |
| ** | PAR02290 |
| ** | PAR02300 |
| ** | PAR02310 |
| ** | PAR02320 |
| ** | PAR02330 |
| ** | PAR02340 |
| ** | PAR02350 |
| ** | PAR02360 |
| ** | PAR02370 |
| ** | PAR02380 |
| ** | PAR02390 |
| ** | PAR02400 |
| ** | PAR02410 |
| ** | PAR02420 |
| ** | PAR02430 |
| ** | PAR02440 |
| ** | PAR02450 |
| ** | PAR02460 |
| ** | PAR02470 |
| ** | PAR02480 |
| ** | PAR02490 |
| ** | PAR02500 |
| ** | PAR02510 |
| ** | PAR02520 |
| ** | PAR02530 |
| ** | PAR02540 |
| ** | PAR02550 |
| ** | PAR02560 |
| ** | PAR02570 |
| ** | PAR02580 |
| ** | PAR02590 |
| ** | PAR02600 |



```

SUBROUTINE COND(QRY,ICOL1,CODE,ARG2,ARG4,IER)
  INTEGER #2 QRY(80),CODE(20)
  COMMON /CHAR/A,B,C,D,E,F,G,H,I,L,M,N,O,P,Q,R,S,T,U,V,W,X,
  -BLANK,COMMA,STAR,LPAR,RPAR
  INTEGER #2 A,B,C,D,E,F,G,H,I,L,M,N,O,P,Q,R,S,T,U,V,W,X,
  -BLANK,COMMA,STAR,LPAR,RPAR
  REAL ARG2,ARG4
  IER=0

```

C  
C  
C

```

CHECK IF WORD 'FOR' EXIST

```

```

  IF(QRY(ICOL1).EQ.F) GO TO 10

```

```

  IER=501

```

```

  RETURN

```

```

  IF(QRY(ICOL1+1).EQ.O.AND.QRY(ICOL1+2).EQ.R) GO TO 20

```

```

  IER=502

```

```

  RETURN

```

```

  ICOL1=ICOL1+3

```

```

  IF(QRY(ICOL1).EQ.BLANK) CALL GETNCH(QRY,ICOL1,BLANK,IER)

```

```

  IF(IER.NE.0) RETURN

```

C  
C  
C

```

CHECK FOR LEFT PARENTHESIS

```

```

  IF(QRY(ICOL1).EQ.LPAR) GO TO 30

```

```

  IER=503

```

```

  RETURN

```

```

  ICOL1=ICOL1+1

```

```

  IF(QRY(ICOL1).EQ.BLANK) CALL GETNCH(QRY,ICOL1,BLANK,IER)

```

```

  IF(IER.NE.0) RETURN

```

C  
C  
C  
C

```

IF 1ST KIND OF CONDITIONAL PHRASE CALL SIMCOD

```

```

INDEX=4

```

```

  IF(QRY(ICOL1).EQ.S.AND.QRY(ICOL1+1).EQ.T) GO TO 40

```

```

  CALL SIMCOD(QRY,ICOL1,CODE,ARG2,INDEX,IER)

```

```

  IF(IER.NE.0) RETURN

```

```

  DO 1 J=1,15

```

```

    IF(QRY(ICOL1+J).NE.BLANK) GO TO 1

```

```

    ICOL1=ICOL1+J-1

```

```

  GO TO 50

```

```

CONTINUE

```

```

  IER=504

```

```

  RETURN

```

```

  IF(QRY(ICOL1).EQ.RPAR) RETURN

```

```

  CALL GETNCH(QRY,ICOL1,BLANK,IER)

```

```

  IF(IER.NE.0) RETURN

```

1  
50

PAR02610  
PAR02620  
PAR02630  
PAR02640  
PAR02650  
PAR02660  
PAR02670  
PAR02680  
PAR02690  
PAR02700  
PAR02710  
PAR02720  
PAR02730  
PAR02740  
PAR02750  
PAR02760  
PAR02770  
PAR02780  
PAR02790  
PAR02800  
PAR02810  
PAR02820  
PAR02830  
PAR02840  
PAR02850  
PAR02860  
PAR02870  
PAR02880  
PAR02890  
PAR02900  
PAR02910  
PAR02920  
PAR02930  
PAR02940  
PAR02950  
PAR02960  
PAR02970  
PAR02980  
PAR02990  
PAR03000  
PAR03010  
PAR03020  
PAR03030  
PAR03040  
PAR03050  
PAR03060  
PAR03070  
PAR03080









```

120      IER=512
      RETURN
      IF (QRY(ICOL1).NE.U) GO TO 130
      CODE(INDEX+1)=3
      IF (QRY(ICOL1+1).EQ.L) GO TO 301
      IER=513
      RETURN
130      IF (QRY(ICOL1).NE.E) GO TO 140
      CODE(INDEX+1)=4
      IF (QRY(ICOL1+1).EQ.Q) GO TO 301
      IF (QRY(ICOL1+1).EQ.R) GO TO 131
      IER=514
      RETURN
140      IF (QRY(ICOL1+1).NE.C) GO TO 150
      IF (QRY(ICOL1).NE.V) GO TO 141
      CODE(INDEX+1)=5
      GO TO 301
141      IF (QRY(ICOL1).NE.S) GO TO 142
      CODE(INDEX+1)=6
      GO TO 301
142      IF (QRY(ICOL1).NE.F) GO TO 143
      CODE(INDEX+1)=7
      GO TO 301
143      CODE(INDEX+1)=8
      IF (QRY(ICOL1).EQ.B) GO TO 301
      IER=515
      RETURN
150      IF (QRY(ICOL1+1).NE.R) GO TO 160
      IF (QRY(ICOL1).NE.V) GO TO 151
      CODE(INDEX+1)=9
      GO TO 301
151      IF (QRY(ICOL1).NE.S) GO TO 152
      CODE(INDEX+1)=10
      GO TO 301
152      IF (QRY(ICOL1).NE.R) GO TO 153
      CODE(INDEX+1)=11
      GO TO 301
153      IF (QRY(ICOL1).NE.F) GO TO 154
      CODE(INDEX+1)=12
      GO TO 301
154      IF (QRY(ICOL1).NE.E) GO TO 155
131      CODE(INDEX+1)=13
      GO TO 301
155      CODE(INDEX+1)=14
      IF (QRY(ICOL1).EQ.T) GO TO 301
      IER=516
      RETURN
160      IF (QRY(ICOL1+1).NE.P) GO TO 170

```

```

PAR03570
PAR03580
PAR03590
PAR03600
PAR03610
PAR03620
PAR03630
PAR03640
PAR03650
PAR03660
PAR03670
PAR03680
PAR03690
PAR03700
PAR03710
PAR03720
PAR03730
PAR03740
PAR03750
PAR03760
PAR03770
PAR03780
PAR03790
PAR03800
PAR03810
PAR03820
PAR03830
PAR03840
PAR03850
PAR03860
PAR03870
PAR03880
PAR03890
PAR03900
PAR03910
PAR03920
PAR03930
PAR03940
PAR03950
PAR03960
PAR03970
PAR03980
PAR03990
PAR04000
PAR04010
PAR04020
PAR04030
PAR04040

```







```

C ***** SUBROUTINE SIMCOD(QRY,ICOL1,CODE,ARG2,INDEX,IER)
C ***** INTEGER #2 QRY(80),CODE(20)
C ***** COMMON /CHAR/A,B,C,D,E,F,G,H,I,L,M,N,O,P,Q,R,S,T,U,V,W,X,
C ***** -BLANK,COMMA,STAR,LPAR,RPAR
C ***** -INTEGER #2 A,B,C,D,E,F,G,H,I,L,M,N,O,P,Q,R,S,T,U,V,W,X,
C ***** -BLANK,COMMA,STAR,LPAR,RPAR
C ***** REAL ARG2,ARG4
C ***** IER=0
C ***** IFLAG=0
C ***** FINE ARG1 AND ARG2.
C ***** IF(QRY(ICOL1).NE.X) GO TO 20
C ***** CODE(INDEX+IFLAG)=1
C ***** GO TO 100
C ***** IF(QRY(ICOL1).NE.S.AND.QRY(ICOL1).NE.C) GO TO 30
C ***** CODE(INDEX+IFLAG)=2
C ***** GO TO 100
C ***** IF(QRY(ICOL1).NE.L) GO TO 40
C ***** CODE(INDEX+IFLAG)=3
C ***** GO TO 100
C ***** IF(QRY(ICOL1).NE.U) GO TO 50
C ***** CODE(INDEX+IFLAG)=4
C ***** GO TO 100
C ***** IF(QRY(ICOL1).NE.D) GO TO 60
C ***** CODE(INDEX+IFLAG)=5
C ***** GO TO 100
C ***** IF(QRY(ICOL1).NE.P) GO TO 70
C ***** CODE(INDEX+IFLAG)=6
C ***** GO TO 100
C ***** IF(QRY(ICOL1).NE.W) GO TO 80
C ***** CODE(INDEX+IFLAG)=7
C ***** GO TO 100
C ***** IF(IFLAG.NE.0) GO TO 90
C ***** IER=601
C ***** RETURN
C ***** DO 1 J=1,12
C ***** IF(QRY(ICOL1+J).NE.BLANK) GO TO 1
C ***** ICOL2=ICOL1+J-1
C ***** GO TO 91
C ***** CCNTINUE
C ***** IER=602
C ***** RETURN
C ***** IF(QRY(ICOL2).EQ.RPAR) ICOL2=ICOL2-1
C ***** ARG2=VAL(QRY,ICOL1,ICOL2)
C ***** CCODE(INDEX+2)=9
C ***** RETURN
PAR04530
PAR04540
PAR04550
PAR04560
PAR04570
PAR04580
PAR04590
PAR04600
PAR04610
PAR04620
PAR04630
PAR04640
PAR04650
PAR04660
PAR04670
PAR04680
PAR04690
PAR04700
PAR04710
PAR04720
PAR04730
PAR04740
PAR04750
PAR04760
PAR04770
PAR04780
PAR04790
PAR04800
PAR04810
PAR04820
PAR04830
PAR04840
PAR04850
PAR04860
PAR04870
PAR04880
PAR04890
PAR04900
PAR04910
PAR04920
PAR04930
PAR04940
PAR04950
PAR04960
PAR04970
PAR04980
PAR04990
PAR05000

```





|     |   |          |
|-----|---|----------|
| C   | FIND RELATIONAL OPERATOR (GT, EQ, E.T.C.)           | PAR05010 |
| C   | IF (IFLAG.NE.0) RETURN                              | PAR05020 |
| 100 | IFLAG=2   | PAR05030 |
|     | CALL GETNCH(QRY,ICOL1,BLANK,IER)                    | PAR05040 |
|     | IF (IER.NE.0) RETURN                                | PAR05050 |
|     | IF (QRY(ICOL1).NE.G) GO TO 11                       | PAR05060 |
|     | IF (QRY(ICOL1+1).NE.T) GO TO 12                     | PAR05070 |
|     | CODE(INDEX+1)=3                                     | PAR05080 |
|     | GO TO 101   | PAR05090 |
| 12  | CODE(INDEX+1)=4                                     | PAR05100 |
|     | IF (QRY(ICOL1+1).EQ.E) GO TO 101                    | PAR05110 |
|     | IER=603   | PAR05120 |
|     | RETURN  | PAR05130 |
| 11  | IF (QRY(ICOL1).NE.L) GO TO 21                       | PAR05140 |
|     | IF (QRY(ICOL1+1).NE.T) GO TO 22                     | PAR05150 |
|     | CODE(INDEX+1)=5                                     | PAR05160 |
|     | GO TO 101   | PAR05170 |
| 22  | CODE(INDEX+1)=6                                     | PAR05180 |
|     | IF (QRY(ICOL1+1).EQ.E) GO TO 101                    | PAR05190 |
|     | IER=604   | PAR05200 |
|     | RETURN  | PAR05210 |
| 21  | IF (QRY(ICOL1).NE.E) GO TO 31                       | PAR05220 |
|     | CODE(INDEX+1)=1                                     | PAR05230 |
|     | IF (QRY(ICOL1+1).EQ.Q) GO TO 101                    | PAR05240 |
|     | IER=605   | PAR05250 |
|     | RETURN  | PAR05260 |
| 31  | IF (QRY(ICOL1).NE.N) GO TO 41                       | PAR05270 |
|     | CODE(INDEX+1)=2                                     | PAR05280 |
|     | IF (QRY(ICOL1+1).EQ.E) GO TO 101                    | PAR05290 |
|     | IER=606   | PAR05300 |
|     | RETURN  | PAR05310 |
| 41  | IF (QRY(ICOL1).NE.M) GO TO 51                       | PAR05320 |
|     | IF (QRY(ICOL1+1).NE.I) GO TO 52                     | PAR05330 |
|     | CODE(INDEX+1)=7                                     | PAR05340 |
|     | IF (QRY(ICOL1+2).EQ.N) RETURN                       | PAR05350 |
|     | IER=607   | PAR05360 |
|     | RETURN  | PAR05370 |
| 52  | CODE(INDEX+1)=8                                     | PAR05380 |
|     | IF (QRY(ICOL1+1).EQ.A.AND.QRY(ICOL1+2).EQ.X) RETURN | PAR05390 |
|     | IER=608   | PAR05400 |
|     | RETURN  | PAR05410 |
| 51  | IER=609   | PAR05420 |
|     | RETURN  | PAR05430 |
| 101 | CALL GETNCH(QRY,ICOL1,BLANK,IER)                    | PAR05440 |
|     | IF (IER.EQ.0) GO TO 99                              | PAR05450 |
|     | RETURN  | PAR05460 |
|     | END   | PAR05470 |
|     |   | PAR05480 |











```

MET=0
DO 1 I=IST, IED
  IF(X(I).EQ.MINUS) GO TO 10
  IF(X(I).EQ.BLANK) GO TO 1
  MET=MET+1
  IF(X(I).NE.DECIM) GO TO 20
  LEXP=MET
  GO TO 1
  ITEMP=X(I)-ZERO
  ITEMP=ITEMP/LL
  WRITE(6,100) IFN, ITEMP
  FORMAT(5X, I10, I10)
  IFN=IFN*10+ITEMP
  GO TO 1
  SIGN=-1.
  CONTINUE
  LEXP=MET-IEXP
  IF(IEXP.EQ.0) LEXP=0
  VAL=SIGN*IFN*10.**(-LEXP)
  RETURN
END

```

```

*****
* SUBROUTINE READF ACCEPTS AS INPUT A FILE IN 'STANDARD'
* FORMAT WITH FILE NUMBER ,IFLR, PACKS IT IN SPARSE DATA
* STRUCTURE, WRITES IT IN A DIRECT ACCESS FILE 'IFLW' IN PACKED
* FORM AND RETURNS THE PACKED FILE IN 'SOLFIL' WITH INFORMATIONS
* ABOUT THE SIZE OF FILE:
* SOLFIL(1) = SIZE OF FILE IN 4-BYTE WORDS
* SOLFIL(2) = 0 (DATA STRUCTURE SPARSE)
* SOLFIL(3) = NUMBER OF ROWS
* SOLFIL(4) = NUMBER OF COLUMNS
*****
*

```

```

SUBROUTINE READF(NROWS,NCOL,IER,IFLR,IFLW)
  REAL DATA(7), SOLIST(1)
  INTEGER*2 CSTAT(15), SOFLAG(1), STAT
  LOGICAL*1 BITS(16)
  COMMON /INIT/ZERO, TINF, IACT, MEMOR
  COMMON /SOLPAC/SOLFIL(81920)
  EQUIVALENCE (SOLFIL(5), SJFLAG(1), SOLIST(1))
  DATA CSTAT/2HIN, 2HBS, 2HLL, 2HUL, 2HEQ, 2HVC, 2HSC, 2HFC, 2HBC,
    -2HVR, 2HSR, 2HRR, 2HFR, 2HER, 2HTR/
  IER=0

```

```

C DEFINE THE TAPE FILE UNDER CP/CMS.
C SEE TAPSET SUBROUTINE IN CP/CMS MANUAL.

```





```

C      CALL TAPSET(2,IFLR,80,17,1,80)
C
C      READ IN NR0WS, NCOL AND IFLP
C      IF IFLP=0 THERE ARE NOT PENALTIES IN THE FILE
C
100    READ(IFLR,100) NR0WS,NCOL,IFLGP
        FORMAT(15,30X,15,10X,11)
        SOLFIL(2)=1
        SOLFIL(3)=NR0WS
        SOLFIL(4)=NCOL
        NRCOL=NR0WS+NCOL
        ICFFS=3*NRCCL
        INDEX=IOFFS+1
        DO 1 I=1,NRCOL
            J=I*3-2
            DATA(6)=0.
            DATA(7)=0.
C
C      READ ONE RECORD AT A TIME
C      IOFFS= THE LAST WORD USED BY NAMES AND FLAGS.
C      INDEX= NEXT AVAILABLE LOCATION TO STORE A NUMBER.
C
201    READ(IFLR,200,END=99) SOLIST(J),SOLIST(J+1),STAT,(DATA(L),L=1,5)
        IF(IFLGP.NE.0) READ(IFLR,201,END=99) DATA(6),DATA(7)
        FORMAT(E14.5,16X,E14.5)
        JW=J
        FORMAT(2A4,A2,5E14.5)
        K=I*6
        SCFLAG(K)=INDEX-IOFFS-1
C
C      FIND THE STATUS OF THE CURRENT RECORD.
        DO 2 J=1,15
            IF(STAT.NE.CSTAT(J)) GO TO 2
            ICOD=J-1
            GO TO 90
        CONTINUE
        IER=1001
        RETURN
        1HELP=ICOD
90
C      UPDATE THE 4 FIRST BITS.
C
        DO 3 J=1,4
            BITS(5-J)=.FALSE.
            IF(MOD(IHELP,2).EQ.1) BITS(5-J)=.TRUE.
            1HELP=IHELP/2
        CONTINUE
3

```



C  
C  
C  
C

CHECK IF VALUES ARE ELIGIBLE FOR STORAGE AND  
UPDATE THE CORRESPNDING BITS.

```
    BITS(5)=.TRUE.  
    IF(DATA(1).EQ.0.) GO TO 10  
    BITS(5)=.FALSE.  
    SCLIST(INDEX)=DATA(1)  
    INDEX=INDEX+1  
    BITS(6)=.TRUE.  
    IF(DATA(2).EQ.0.) GO TO 20  
    BITS(6)=.FALSE.  
    SCLIST(INDEX)=DATA(2)  
    INDEX=INDEX+1  
    BITS(7)=.TRUE.  
    BITS(10)=.FALSE.  
    IF(DATA(3).EQ.0.) GO TO 30  
    IF(ICOD.EQ.2.OR.ICOD.EQ.4) GO TO 30  
    IF(DATA(3).EQ.-1INF) GO TO 25  
    BITS(7)=.FALSE.  
    SCLIST(INDEX)=DATA(3)  
    INDEX=INDEX+1  
    GO TO 30
```

10

20

25  
30

```
    BITS(10)=.TRUE.  
    BITS(8)=.TRUE.  
    BITS(11)=.FALSE.  
    IF(DATA(4).EQ.0.) GO TO 40  
    IF(ICOD.EQ.3.OR.ICOD.EQ.4) GO TO 40  
    IF(DATA(4).EQ.-1INF) GO TO 35  
    BITS(8)=.FALSE.  
    SCLIST(INDEX)=DATA(4)  
    INDEX=INDEX+1  
    GO TO 40
```

35  
40

```
    BITS(11)=.TRUE.  
    BITS(9)=.TRUE.  
    IF(DATA(5).EQ.0.) GO TO 50  
    BITS(9)=.FALSE.  
    SCLIST(INDEX)=DATA(5)  
    INDEX=INDEX+1
```

C  
C  
C  
50

CHECK THE STATUS OF PENALTIES.

```
    IHELP=10  
    IF(DATA(6).EQ.0.) GO TO 60  
    IHELP=30  
    IF(DATA(6).EQ.-1INF) GO TO 60  
    IHELP=20  
    SCLIST(INDEX)=DATA(6)
```

REA000760  
REA000770  
REA000780  
REA000790  
REA000800  
REA000810  
REA000820  
REA000830  
REA000840  
REA000850  
REA000860  
REA000870  
REA000880  
REA000890  
REA000900  
REA000910  
REA000920  
REA000930  
REA000940  
REA000950  
REA000960  
REA000970  
REA000980  
REA000990  
REA010000  
REA010100  
REA010200  
REA010300  
REA010400  
REA010500  
REA010600  
REA010700  
REA010800  
REA010900  
REA011000  
REA011100  
REA011200  
REA011300  
REA011400  
REA011500  
REA011600  
REA011700  
REA011800  
REA011900  
REA012000  
REA012100  
REA012200  
REA012300







```

C C C C C C
* * * * *
SUBROUTINE READD IS EXACTLY AS THE SUBROUTINE READD
WITH THE ONLY DIFFERENCE THAT IT PACKS THE SOLUTION FILE
INTO THE SUPERSPARSE DATA STRUCTURE.
* * * * *
SUBROUTINE READD(NROWS,NCOL,IER,IFLR,IFLW)
REAL DATA(7),SOLIST(1)
INTEGER*2 CSTAT(15),SOFLAG(1),STAT
LOGICAL*1 BITS(16)
COMMON /INIT/ZERO,TINF,IAC, MEMOR
COMMON /SOLPAC/SOLFIL(81920)
EQUIVALENCE (SOLFIL(5),SOLIST(1),SOFLAG(1))
DATA CSTAT/2HIN,2HBS,2HLL,2HUL,2HEQ,2HVC,2HSC,2HFC,2HBC,
-2HVR,2HSR,2HRR,2HFR,2HER,2HR/
IER=0
CALL TAPSET (2,IFLR,80,17,1,80)
READ(IFLR,100) NROWS,NCOL,1IFLGP
FORMAT(15,30X,15,10X,11)
IEND=MEMOR-4
II=IEND
NRCOL=NROWS+NCOL
IOFFS=6*NRCOL
INDEX=IOFFS+1
DO 1 I=1,NRCOL
J=I*3-2
DATA(6)=0.
DATA(7)=0.
READ(IFLR,200) SOLIST(J),SOLIST(J+1),STAT,(DATA(L),L=1,5)
IF(1IFLGP.NE.0) READ(IFLR,201,END=99) DATA(6),DATA(7)
FORMAT(E14.5,16X,E14.5)
JW=J
DO 7 J=1,7
IF(DATA(J).EQ.0..OR.DATA(J).GE.TINF) GO TO 7
DO 8 K=1,IEND
IF(DATA(J).NE.SOLIST(K)) GO TO 8
DATA(J)=K
GO TO 7
CONTINUE
SOLIST(11)=DATA(J)
DATA(J)=11
II=II-1
CONTINUE
FORMAT(2A4,A2,5E14.5)
K=I*6
SOFLAG(K)=INDEX-IOFFS-1
DO 2 J=1,15

```

```

REA00020
REA00030
REA00040
REA00050
REA00060
REA00070
REA00080
REA00090
REA00100
REA00110
REA00120
REA00130
REA00140
REA00150
REA00160
REA00170
REA00180
REA00190
REA00200
REA00210
REA00220
REA00230
REA00240
REA00250
REA00260
REA00270
REA00280
REA00290
REA00300
REA00310
REA00320
REA00330
REA00340
REA00350
REA00360
REA00370
REA00380
REA00390
REA00400
REA00410
REA00420
REA00430
REA00440
REA00450
REA00460
REA00470
REA00480
REA00490

```





```

2      IF(STAT,NE,CSTAT(J)) GO TO 2
      ICOD=J-1
      GO TO 90
      CCNTINUE
      IER=1001
      RETURN
      IHELP=ICOD
      DO 3 J=1,4
      BITS(5-J)=.FALSE.
      IF(MOD(IHELP,2).EQ.1) BITS(5-J)=.TRUE.
      IHELP=IHELP/2
      CCNTINUE
      BITS(5)=.TRUE.
      IF(DATA(1).EQ.0.) GO TO 10
      BITS(5)=.FALSE.
      SCFLAG(INDEX)=IEND-DATA(1)
      INDEX=INDEX+1
      BITS(6)=.TRUE.
      IF(DATA(2).EQ.0.) GO TO 20
      BITS(6)=.FALSE.
      SCFLAG(INDEX)=IEND-DATA(2)
      INDEX=INDEX+1
      BITS(7)=.TRUE.
      BITS(10)=.FALSE.
      IF(DATA(3).EQ.0.) GO TO 30
      IF(ICOD.EQ.2.OR.ICOD.EQ.4) GO TO 25
      IF(DATA(3).EQ.-TINF) GO TO 25
      BITS(7)=.FALSE.
      SCFLAG(INDEX)=IEND-DATA(3)
      INDEX=INDEX+1
      GO TO 30
      BITS(10)=.TRUE.
      BITS(8)=.TRUE.
      BITS(11)=.FALSE.
      IF(DATA(4).EQ.0.) GO TO 40
      IF(ICOD.EQ.3.OR.ICOD.EQ.4) GO TO 35
      IF(DATA(4).EQ.-TINF) GO TO 35
      BITS(8)=.FALSE.
      SCFLAG(INDEX)=IEND-DATA(4)
      INDEX=INDEX+1
      GO TO 40
      BITS(11)=.TRUE.
      BITS(9)=.TRUE.
      IF(DATA(5).EQ.0.) GO TO 50
      BITS(9)=.FALSE.
      SCFLAG(INDEX)=IEND-DATA(5)
      INDEX=INDEX+1
      IHELP=10

```

```

REAO0500
REAO0510
REAO0520
REAO0530
REAO0540
REAO0550
REAO0560
REAO0570
REAO0580
REAO0590
REAO0600
REAO0610
REAO0620
REAO0630
REAO0640
REAO0650
REAO0660
REAO0670
REAO0680
REAO0690
REAO0700
REAO0710
REAO0720
REAO0730
REAO0740
REAO0750
REAO0760
REAO0770
REAO0780
REAO0790
REAO0800
REAO0810
REAO0820
REAO0830
REAO0840
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REAO0870
REAO0880
REAO0890
REAO0900
REAO0910
REAO0920
REAO0930
REAO0940
REAO0950
REAO0960
REAO0970

```



REA00980  
 REA00990  
 REA01000  
 REA01010  
 REA01020  
 REA01030  
 REA01040  
 REA01050  
 REA01060  
 REA01070  
 REA01080  
 REA01090  
 REA01100  
 REA01110  
 REA01120  
 REA01130  
 REA01140  
 REA01150  
 REA01160  
 REA01170  
 REA01180  
 REA01190  
 REA01200  
 REA01210  
 REA01220  
 REA01230  
 REA01240  
 REA01250  
 REA01260  
 REA01270  
 REA01280  
 REA01290  
 REA01300  
 REA01310  
 REA01320  
 REA01330  
 REA01340  
 REA01350  
 REA01360  
 REA01370  
 REA01380  
 REA01390  
 REA01400  
 REA01410  
 REA01420  
 REA01430  
 REA01440  
 REA01450

```

IF(DATA(6).EQ.0.) GO TO 60
IHELP=30
IF(DATA(6).EQ.TINF) GO TO 60
IHELP=20
SFLAG(INDEX)=IEND-DATA(6)
INDEX=INDEX+1
IHELP=1
IF(DATA(7).EQ.0.) GO TO 70
IHELP=3
IF(DATA(7).EQ.TINF) GO TO 70
IHELP=2
SFLAG(INDEX)=IEND-DATA(7)
INDEX=INDEX+1
IHELP=IHELP+IHELP1
ICOD=IHELP-11
IF(IHELP.LE.13) GO TO 80
ICOD=IHELP-18
IF(IHELP.LE.23) GO TO 80
ICOD=IHELP-25
DC 4 J=1,4
BITS(16-J)=.FALSE.
IF(MOD(ICOD,2).EQ.1) BITS(16-J)=.TRUE.
ICOD=ICOD/2
CONTINUE
BITS(16)=.FALSE.
IHELP=0
DO 5 J=1,16
IF(BITS(17-J)) IHELP=IHELP+2**((J-1)
CONTINUE
SFLAG(K-1)=IHELP
CONTINUE
IF(MOD(INDEX,2).NE.0) INDEX=INDEX-1
INDEX=INDEX/2
DC 11 J=1,11,IEND
INDEX=INDEX+1
SOLIST(INDEX)=SOLIST(J)
CONTINUE
INDEX=INDEX+4
WRITE(6,300) INDEX
FORMAT(5X,'WORDS REQUIRED FOR PACKED FILE: ',I6)
SOLFIL(1)=INDEX
SOLFIL(2)=0
SOLFIL(3)=NROWS
SOLFIL(4)=NCOL
WRITE(IFLW,1) (SOLFIL(I),I=1,INDEX)
RETURN
WRITE(6,999) SOLIST(JW),SOLIST(JW+1),STAT,(DATA(L),L=1,5)
FORMAT(2X,2A4,A2,5F14.5)
99
999

```



```

IER=1002
RETURN
END
C C C C C C C C C C
*****
* SUBROUTINE INTERP EXECUTES THE QUERY USING THE CODE
* GENERATED BY THE PARSE SUBROUTINE.
* CODE - THE CODE GENERATED BY THE PARSE
* MASK - THE MASK FIELD OF THE QUERY
* ARG2, ARG4 - THE VALUES OF ARG1, ARG2 OF CONDITION FIELD
* K1, K2, K3 - AS THEY ARE SET BY THE SET COMMAND
* K1=START K2=END K3=STEP
*****
* SUBROUTINE INTERP(CODE,MASK,ARG2,ARG4,K1,K2,K3,NROWS,NCOL,BLANK,ST
-AR,IER,IFLG)
COMMON /INIT/ZERO,TINF,IACT
INTEGER #2 BLANK,STAR,CODE(20),NAME(8),MASK(8),SNAME(8),SOFLAG(1)
COMMON /SOLPAC/SOLFIL(81920)
EQUIVALENCE (SOLFIL(5),SOLIST(1),SOFLAG(1))
INTEGER PROP(7)
REAL SOLIST(1),RECORD(7),RECAD(7)
LOGICAL EVCOD,EVMN
IER=0
C C C C C C C C C C
SET UP INFORMATION FOR PRINT RESULTS.
INITIALIZE VALUES FOR MINIMUM AND MAXIMUM.
IPRINT=2
SMIN=.7273E74
SMAX=-SMIN
DO 4 J=1,7
RECAD(J)=0.
PROP(J)=0.
IF(CODE(11).EQ.0) PROP(J)=J
CONTINUE
IF(CODE(11).EQ.0) GO TO 12
DO 5 I=1,7
JSAVE=0
DO 6 J=12,18
IF(CODE(J).NE.1) GO TO 6
JSAVE=J
GO TO 11
CONTINUE
IF(JSAVE.EQ.0) GO TO 12
PROP(1)=JSAVE-11
CONTINUE
C C C C C C C C C C

```



```

C          SET UP LIMITS FOR SEARCHING.
C
C12        NEND=K2
C          NCUR=K1
C          IF(CODE(2).EQ.3.AND.K2.GT.NROWS) NEND=NROWS
C          IF(CODE(2).NE.2) GO TO 91
C          NEND=NROWS+K3+K1-1
C          NEND=NROWS+K2
C          IF(NEND.GT.(NROWS+NCOL)) NEND=NROWS+NCOL
C          IF(CODE(2).EQ.3) IPRINT=3
C          NCUR=NCUR-K3
C          ICOUNT=0
C          NCUR=NCUR+K3
C          IF(NCUR.LE.NEND) GO TO 10
C
C          IF END OF SEARCHING PRINT BOTTOM LINE.
C
C          IF(CODE(1).NE.17.OR.CODE(2).NE.1) GO TO 105
C          IACT=0
C          WRITE(6,500)
C          FORMAT(10X,' F I L E   U E A C T I V E ',//)
C          RETURN
C500        IF(CODE(4).NE.9.AND.CODE(5).GT.6)CALL PRRES(CODE, SNAME, RECAD, ICODEM
105        -X, ICOUNT, PROP)
C90        CALL PRBOT(CODE, RECORD, RECAD, ICOUNT, MASK, PRCP, IPRINT)
C          RETURN
C10        IF(IACT.EQ.0) GO TO 102
C
C          CHECK IF ACTIVE FILE EXISTS.
C          IF IT IS CHECK IF CURRENT RECORD ACTIVE.
C          IF NOT GET THE NEXT RECORD IF ANY.
C
C          IHELP=SOFLAG(NCUR*6-1)
C          IF(MOD(IHELP,2).EQ.0.AND.CODE(1).NE.16) GO TO 99
C          IF(MOD(IHELP,2).EQ.1.AND.CODE(1).EQ.16) GO TO 99
C          IF(CODE(1).NE.17.OR.CODE(2).NE.1) GO TO 102
C          SOFLAG(NCUR*6-1)=SOFLAG(NCUR*6-1)-1
C          GO TO 99
C
C          PUT BLANKS TO THE NAME.
C
C          DO 2 J=1,8
C            NAME(J)=BLANK
C          CONTINUE
C102
C          GET THE NAME OF CURRENT RECORD.
C          CALL CURNAM(MASK, NAME, NCUR, BLANK, STAR)
C
C          INT00460
C          INT00470
C          INT00480
C          INT00490
C          INT00500
C          INT00510
C          INT00520
C          INT00530
C          INT00540
C          INT00550
C          INT00560
C          INT00570
C          INT00580
C          INT00590
C          INT00600
C          INT00610
C          INT00620
C          INT00630
C          INT00640
C          INT00650
C          INT00660
C          INT00670
C          INT00680
C          INT00690
C          INT00700
C          INT00710
C          INT00720
C          INT00730
C          INT00740
C          INT00750
C          INT00760
C          INT00770
C          INT00780
C          INT00790
C          INT00800
C          INT00810
C          INT00820
C          INT00830
C          INT00840
C          INT00850
C          INT00860
C          INT00870
C          INT00880
C          INT00890
C          INT00900
C          INT00910
C          INT00920
C          INT00930

```





|     |  |          |
|-----|--|----------|
| C   | CHECK IF NAME MATCHES TO THE MASK.                                       | INT00940 |
| C   | IF NOT GET THE NEXT RECORD.  | INT00950 |
| C   |  | INT00960 |
| 70  |  | INT00970 |
| C   | DO 1 I=1,8   | INT00980 |
| 1   | IF(MASK(I)).EQ.STAR) GO TO 1   | INT00990 |
| C   | IF(MASK(I)).NE.NAME(I)) GO TO 99   | INT01000 |
| C   | CONTINUE   | INT01010 |
| C   |  | INT01020 |
| C   | IF IFLG=0 (SPARSE STRUCTURE) CALL DEPACK TO GET                          | INT01030 |
| 20  | THE VALUES OF CURRENT RECORD ELSE CALL DPAC.                             | INT01040 |
| C   |  | INT01050 |
| C   | IF(IFLG.EQ.0) GO TO 201  | INT01060 |
| 201 | CALL DEPACK(CODE, ICOD, RECORD, NCUR, BLANK, NROWS, NCOL, IER)           | INT01070 |
| 202 | GO TO 202  | INT01080 |
| C   | CALL DPAC(CODE, ICOD, RECORD, NCUR, BLANK, NROWS, NCOL, IER)             | INT01090 |
| C   | IF(IER.NE.0) RETURN  | INT01100 |
| C   |  | INT01110 |
| C   | IF NO CONDITION FIELD SKIP   | INT01120 |
| C   | ELSE EVALUATE CONDITION USING EVCOD AND EVMN.                            | INT01130 |
| C   |  | INT01140 |
| C   | IF(CODE(4).EQ.0) GO TO 60  | INT01150 |
| C   | IF(CODE(4).EQ.9) GO TO 50  | INT01160 |
| C   | IF(CODE(5).LT.7) GO TO 21  | INT01170 |
| C   | IF(CODE(5).NE.7) GO TO 22  | INT01180 |
| C   |  | INT01190 |
| C   | EVALUATE BOUND CONDITION. (MAX OR MIN)                                   | INT01200 |
| C   |  | INT01210 |
| C   | IF(RECORD(CODE(4)).GT.SMIN) GO TO 99                                     | INT01220 |
| C   | IF(RECORD(CODE(4)).EQ.SMIN) GO TO 24                                     | INT01230 |
| 22  | SMIN=RECORD(CODE(4))   | INT01240 |
| C   | GO TO 23   | INT01250 |
| C   | IF(RECORD(CODE(4)).LT.SMAX) GO TO 99                                     | INT01260 |
| C   | IF(RECORD(CODE(4)).EQ.SMAX) GO TO 24                                     | INT01270 |
| 23  | SMAX=RECORD(CODE(4))   | INT01280 |
| C   | ICOUNT=0   | INT01290 |
| C   | DO 7 I=1,7   | INT01300 |
| C   | RECAD(I)=RECORD(I)   | INT01310 |
| 7   | SNAME(I)=NAME(I)   | INT01320 |
| C   | CONTINUE   | INT01330 |
| C   | SNAME(8)=NAME(8)   | INT01340 |
| 24  | ICODMX=ICOD  | INT01350 |
| C   | ICOUNT=ICOUNT+1  | INT01360 |
| C   | GO TO 99   | INT01370 |
| 21  | IF(EVCOD(CODE, ICOD, RECORD, ARG2, ARG4, IER)) GO TO 60                  | INT01380 |
| C   | GO TO 99   | INT01390 |
| 50  | INDEX=5  | INT01400 |
| C   | IF(.NOT.EVMN(CODE, ICOD, RECORD, INDEX, MIN, MAX, ICOUNT, IER)) GO TO 99 | INT01410 |











```

IHELP=0
ICODP=0
DO 2 I=1,4
IF(BITS(5-I)) IHELP=IHELP+2**(I-1)
IF(BITS(16-I)) ICCDP=ICODP+2**(I-1)"
CONTINUE
ICOD=IHELP
INDEX=IOFFS+SOFLAG(1BITS+1)
IF(SOFLAG(1BITS+1).LT.0) INDEX=INDEX+65536
DC 3 I=1,5
RECORD(1)=0.0
IF(I.EQ.3.AND.(ICOD.EQ.2.OR.ICOD.EQ.4)) GO TO 10
IF(I.EQ.4.AND.(ICOD.EQ.3.OR.ICOD.EQ.4)) GO TO 10
IF(BITS(4+I)) GO TO 3
RECORD(I)=SOLIST(INDEX)
INDEX=INDEX+1
GO TO 3
RECORD(1)=RECORD(1)
CONTINUE
IF(BITS(10)) RECORD(3)=-TINF
IF(BITS(11)) RECORD(4)=TINF
RECORD(6)=0.
IF(ICODP.LE.2) GO TO 20
IF(ICODP.GT.5) GO TO 30
RECORD(6)=SOLIST(INDEX)
INDEX=INDEX+1
GO TO 20
RECORD(6)=TINF
RECORD(7)=0.
IF(ICODP.EQ.0.OR.ICODP.EQ.3.OR.ICODP.EQ.6) RETURN
IF(ICODP.EQ.2.OR.ICODP.EQ.5.OR.ICODP.EQ.8) GO TO 40
RECORD(7)=SOLIST(INDEX)
RETURN
RECORD(7)=TINF
RETURN
END
*****
*
* SUBROUTINE DPAC RETURNS THE SAME VALUES AS DEPACK
* BUT USING THE SUPER SPARSE DATA STRUCTURE.
*
*****
*
* SUBROUTINE DPAC(CODE, ICOD, RECORD, NCUR, BLANK, NRROWS, NCOL, IER)
REAL RECORD(7), SOLIST(1)
INTEGER *2 CODE(20), SOFLAG(1)
LOGICAL *1 BITS(16), SONAME(1)
COMMON /INIT/ZERO, TINF, IACT, MEMOR, ISIZE
COMMON /SOLPAC/SOLFIL(81920)

```







|   |     |
|---|-----|
| EQUIVALENCE (SOLFIL(5),SOLIST(1),SOFLAG(1),SONAME(1)) | 130 |
| IER=0   | 140 |
| IOFFS=6*(NRQWS+NCOL)+1                                | 150 |
| IEND=ISIZE-4  | 160 |
| IBITS=NCUR*6-1  | 170 |
| IHELP=SOFLAG(IBITS)                                   | 180 |
| IF(IHELP.LT.0) IHELP=IHELP+65536                      | 190 |
| DO 1 I=1,16   | 200 |
| BITS(17-I)=.FALSE.                                    | 210 |
| IF(MOD(IHELP,2).EQ.1) BITS(17-I)=.TRUE.               | 220 |
| IHELP=IHELP/2   | 230 |
| CONTINUE  | 240 |
| IHELP=0   | 250 |
| ICODP=0   | 260 |
| DO 2 I=1,4  | 270 |
| IF(BITS(5-I)) IHELP=IHELP+2**((I-1)                   | 280 |
| IF(BITS(16-I)) ICODP=ICODP+2**((I-1)"                 | 290 |
| CONTINUE  | 300 |
| ICOD=IHELP  | 310 |
| INDEX=IOFFS+SOFLAG(IBITS+1)                           | 320 |
| IF(SOFLAG(IBITS+1).LT.0) INDEX=INDEX+65536            | 330 |
| DO 3 I=1,5  | 340 |
| RECORD(I)=0.0   | 350 |
| IF(I.EQ.3.AND.(ICOD.EQ.2.OR.ICOD.EQ.4)) GO TO 10      | 360 |
| IF(I.EQ.4.AND.(ICOD.EQ.3.OR.ICOD.EQ.4)) GO TO 10      | 370 |
| IF(BITS(4+I)) GO TO 3                                 | 380 |
| RECORD(I)=SOLIST(IEND-SOFLAG(INDEX))                  | 390 |
| INDEX=INDEX+1   | 400 |
| GO TO 3   | 410 |
| RECORD(I)=RECORD(1)                                   | 420 |
| CONTINUE  | 430 |
| IF(BITS(10)) RECORD(3)=-TINF                          | 440 |
| IF(BITS(11)) RECORD(4)=TINF                           | 450 |
| RECORD(6)=0.  | 460 |
| IF(ICODP.LE.2) GO TO 20                               | 470 |
| IF(ICODP.GT.5) GO TO 30                               | 480 |
| RECORD(6)=SOLIST(IEND-SOFLAG(INDEX))                  | 490 |
| INDEX=INDEX+1   | 500 |
| GO TO 20  | 510 |
| RECORD(6)=TINF  | 520 |
| RECORD(7)=0.  | 530 |
| IF(ICODP.EQ.0.OR.ICODP.EQ.3.OR.ICODP.EQ.6) RETURN     | 540 |
| IF(ICODP.EQ.2.OR.ICODP.EQ.5.OR.ICODP.EQ.8) GO TO 40   | 550 |
| RECORD(7)=SOLIST(IEND-SOFLAG(INDEX))                  | 560 |
| RETURN  | 570 |
| RECORD(7)=TINF  | 580 |
| RETURN  | 590 |
| END   | 600 |













```

SUBROUTINE PRRES( CODE, NAME, RECORD, ICOD, ICONT, PROP )
  INTEGER*2 NAME(8), CODE(20), HDCOD(15)
  INTEGER PROP(7), FMT1(18), FMT2(18), FMT3(18), FMTN(7)
  REAL RECORD(7)
  TINF=0.1E74
  DATA HDCOD/2HIN,2HBS,2HLL,2HUL,2HEQ,2HVC,2HSC,2HFC,2HEC,2HVR,
-2HSR,2HRR,2HFR,2HER,2HTR/
  DATA FMT1/4H(1H+,4H, T,4H ,4H,2X,,4HF14.,4H5) /
  DATA FMT2/4H(1H+,4H, T,4H ,4H,2X,,4H, ,4H N,
-4FONE,4H) /
  DATA FMT3/4H(1H+,4H, T,4H ,4H,2X,,4H, ,4H I,4HNFIN,
-4HITY,4H) /
  DATA FMTN/7*4H2 /
  DATA FMTN/4H21 ,4H37 ,4H53 ,4H69 ,4H85 ,4H101 ,4H117 /
  IF(CODE(1).NE.13.AND.CODE(1).NE.14) GO TO 4C
  WRITE(6,300)
  FORMAT(1H+, ' SUMS OR AVERAGES : ' )
  GO TO 41
  WRITE(6,100) ICONT, (NAME(I), I=1,8), HDCOD( ICOD+1 )
  FORMAT( 1H+, 15,2X,8A1,2X,A2)
  DC 11 I=1,7
  IHELP=PROP(I)
  IF(IHELP.EQ.0) GO TO 10
  GO TO (1,1,2,2,1,3,3), IHELP
  FMT1(3)=FMTN(I)
  IF(RECORD(IHELP).EQ.0.0) RECORD( IHELP)=0.00C0001
  WRITE(6, FMT1) RECORD( IHELP)
  GO TO 11
  FMT1(3)=FMTN(I)
  IF(ABS(RECORD(IHELP)).GT.TINF) GO TO 21
  IF(RECORD(IHELP).EQ.0.0) RECORD( IHELP)=0.0000001
  WRITE(6, FMT1) RECORD( IHELP)
  FORMAT( 1H+,A4)
  GO TO 11
  FMT2(3)=FMTN(I)
  WRITE(6, FMT2)
  GO TO 11
  FMT1(3)=FMTN(I)
  IF(RECORD(IHELP).EQ.0.0) GO TO 31
  IF(RECORD(IHELP).GT.TINF) GO TO 32
  IF(RECORD(IHELP).EQ.0.0) RECORD( IHELP)=0.0000001
  WRITE(6, FMT1) RECORD( IHELP)
  GO TO 11
  FMT2(3)=FMTN(I)
  WRITE(6, FMT2)
  GO TO 11
  FMT3(3)=FMTN(I)
  WRITE(6, FMT3)

```

```

PRR00080
PRR00090
PRR00100
PRR00110
PRR00120
PRR00130
PRR00140
PRR00150
PRR00160
PRR00170
PRR00180
PRR00190
PRR00200
PRR00210
PRR00220
PRR00230
PRR00240
PRR00250
PRR00260
PRR00270
PRR00280
PRR00290
PRR00300
PRR00310
PRR00320
PRR00330
PRR00340
PRR00350
PRR00360
PRR00370
PRR00380
PRR00390
PRR00400
PRR00410
PRR00420
PRR00430
PRR00440
PRR00450
PRR00460
PRR00470
PRR00480
PRR00490
PRR00500
PRR00510
PRR00520
PRR00530
PRR00540
PRR00550

```





```

11  CONTINUE
10  WRITE(6,200)
200 FORMAT(1H )
RETURN
END
*****
C  SUBROUTINE PRBOT PRINTS THE TOTAL NUMBER OF QUALIFIED
C  RECORDS AFTER THE LAST RECORD PRINTED BY PRRES SUBROUTINE.
C  ALSO IT PRINTS THE RESULTS FROM ADD AND AVERAGE COMMANDS.
C  *****
C  SUBROUTINE PRBOT(CCODE,RECORD,RECAD,ICOUNT,MASK,PRCP,IPRINT)
C  COMMON /IN IT/ZERO,TINF,IAC
C  INTEGER*2 CODE(20),MASK(8)
C  INTEGER PROP(7)
C  REAL RECORD(7),RECAD(7)
C  IF(CODE(1).GT.15) GO TO 30
*****
C  IF ADD OR AVERAGE COMMANDS SKIP TO 10
C
C  IF(CODE(1).EQ.13.OR.CODE(1).EQ.14) GO TO 10
C  FORMAT(2X,7F10.3)
200 WRITE(6,100) ICOUNT,(MASK(I),I=1,8)
21  FORMAT(2X,/,2X,15,2X,'ROWS OR COLUMNS WITH MASK : ',8A1,/,2X,'SATI
100 -SFY THE CONDITIONS')
RETURN
10  IF(CODE(1).EQ.13) GO TO 20
DO 1 J=1,7
RECAD(J)=RECAD(J)/ICOUNT
CONTINUE
1  PROP(1)=1
20  PROP(2)=2
PROP(3)=5
PROP(4)=0
CALL PRHEAD(CODE,PROP,IPRINT)
CALL PRRES(CODE,MASK,RECAD,ICOD,ICOUNT,PROP)
GO TO 21
30  IF(CODE(1).EQ.16) GO TO 31
IAC=IAC-ICOUNT
IAC=IAC+ICOUNT
300 WRITE(6,300) ICOUNT,IAC
FORMAT(5X,/,5X,16,' RECORDS DEACTIVATED',/,5X,' TOTAL RECORDS
- ACTIVE :',16)
RETURN
31  IAC=IAC+ICOUNT
IAC=IAC-ICOUNT
400 WRITE(6,400) ICOUNT,IAC
FORMAT(5X,/,5X,16,' RECORDS ACTIVATED',/,5X,' TOTAL RECORDS ACTI
PRR00560
PRR00570
PRR00580
PRR00590
PRR00600
PRB00010
PRB00020
PRB00030
PRB00040
PRB00050
PRB00060
PRB00070
PRB00080
PRB00090
PRB00100
PRB00110
PRB00120
PRB00130
PRB00140
PRB00150
PRB00160
PRB00170
PRB00180
PRB00190
PRB00200
PRB00210
PRB00220
PRB00230
PRB00240
PRB00250
PRB00260
PRB00270
PRB00280
PRB00290
PRB00300
PRB00310
PRB00320
PRB00330
PRB00340
PRB00350
PRB00360
PRB00370
PRB00380
PRB00390
PRB00400
PRB00410
PRB00420
PRB00430

```







```

56 WRITE(6,505)
505 FORMAT(5X,'INVALID LOGICAL OPERATOR 'OR','AND',' ')
RETURN
57 WRITE(6,506)
506 FORMAT(5X,'INVALID OPERAND FOR STATUS')
RETURN
600 IF(IHELP.EQ.2) GO TO 54
    IF(IHELP.EQ.1) GO TO 61
WRITE(6,601)
601 FORMAT(5X,'INVALID RELATIONAL OPERATOR IN CONDITION FIELD')
RETURN
61 WRITE(6,602)
602 FORMAT(5X,'INVALID FIRST OPERAND FOR RELOP IN CONDITION FIELD')
RETURN
700 WRITE(6,701)
701 FORMAT(5X,'INVALID PRINT FIELD')
RETURN
999 IF(IER.NE.1001) GO TO 900
WRITE(6,801)
801 FORMAT(5X,'ERROR IN INPUT DATA - INVALID STATUS CODE')
RETURN
900 WRITE(6,901)
901 FCRMAT(5X,'ERROR IN INPUT DATA - DATA LESS THAN REQUIRED')
RETURN
END
*****
C * SUBROUTINE TIMER PRINTS THE TIME IN SECONDS THE VIRTUAL
C * MACHINE WAS USED SINCE THE LAST CALL.
C * *****
C *****
C SUBROUTINE TIMER
COMMON ITM(6),TIME
CALL IXCLOCK(ITM)
SEC=ITM(5)/76800.
EL=SEC-TIME
TIME=SEC
WRITE(6,100) EL
100 FORMAT(10X,'EXECUTION TIME FOR QUERY =',F8.4,' SECONDS')
RETURN
END
ERR00460
ERR00470
ERR00480
ERR00490
ERR00500
ERR00510
ERR00520
ERR00530
ERR00540
ERR00550
ERR00560
ERR00570
ERR00580
ERR00590
ERR00600
ERR00610
ERR00620
ERR00630
ERR00640
ERR00650
ERR00660
ERR00670
ERR00680
ERR00690
ERR00700
TIM00010
TIM00020
TIM00030
TIM00040
TIM00050
TIM00060
TIM00070
TIM00080
TIM00090
TIM00100
TIM00110
TIM00120
TIM00130
TIM00140
TIM00150
TIM00160

```











```

REW00470
REW00480
REW00490
REW00500
REW00510
REW00520
REW00530
REW00540
REW00550
REW00560
REW00570
REW00580
REW00590
REW00600
REW00610
REW00620

```

```

99      GC TO 30
        NCOL=MET-NROWS
        WRITE(2,1,600) NROWS,NCOL,IFLGP
        FORMAT(15,30X,15,10X,11)
        IA=1
        READ(2,1A,600) NROWS,NCOL,IFLGP
        ITOT=NR CWS+NCOL
        WRITE(9,600) NROWS,NCOL,IFLGP
        DO 6 I=1,ITOT
          READ(2,1A,700) A
          WRITE(9,700) A
          FORMAT(20A4)
        CONTINUE
        END FILE 9
        STOP
        END
//GO.FT01F001 DD DISP=OLD,UNIT=3400-4,VOL=SER=(NPS251,NPS631),
//DSNAME=MPS LIST,DCB=(RECFM=UA,BLKSIZE=133,DEN=2)
//GO.FT02F001 DD DSN=SI951.STADFM,
//UNIT=3330,VOL=SER=DISK04,
//SPACE=(CYL,(6,1)),DISP=(NEW,KEEP),
//DCB=(RECFM=FB,LRECL=80,BLKSIZE=6400)
//GO.FT09F001 DD UNIT=2400,VOL=SER=NPS713,DISP=(,KEEP),
//LABEL=(,SL),DSN=TAPFOR,DCB=(RECFM=FB,LRECL=80,PLKSIZE=6400,DEN=2)

```



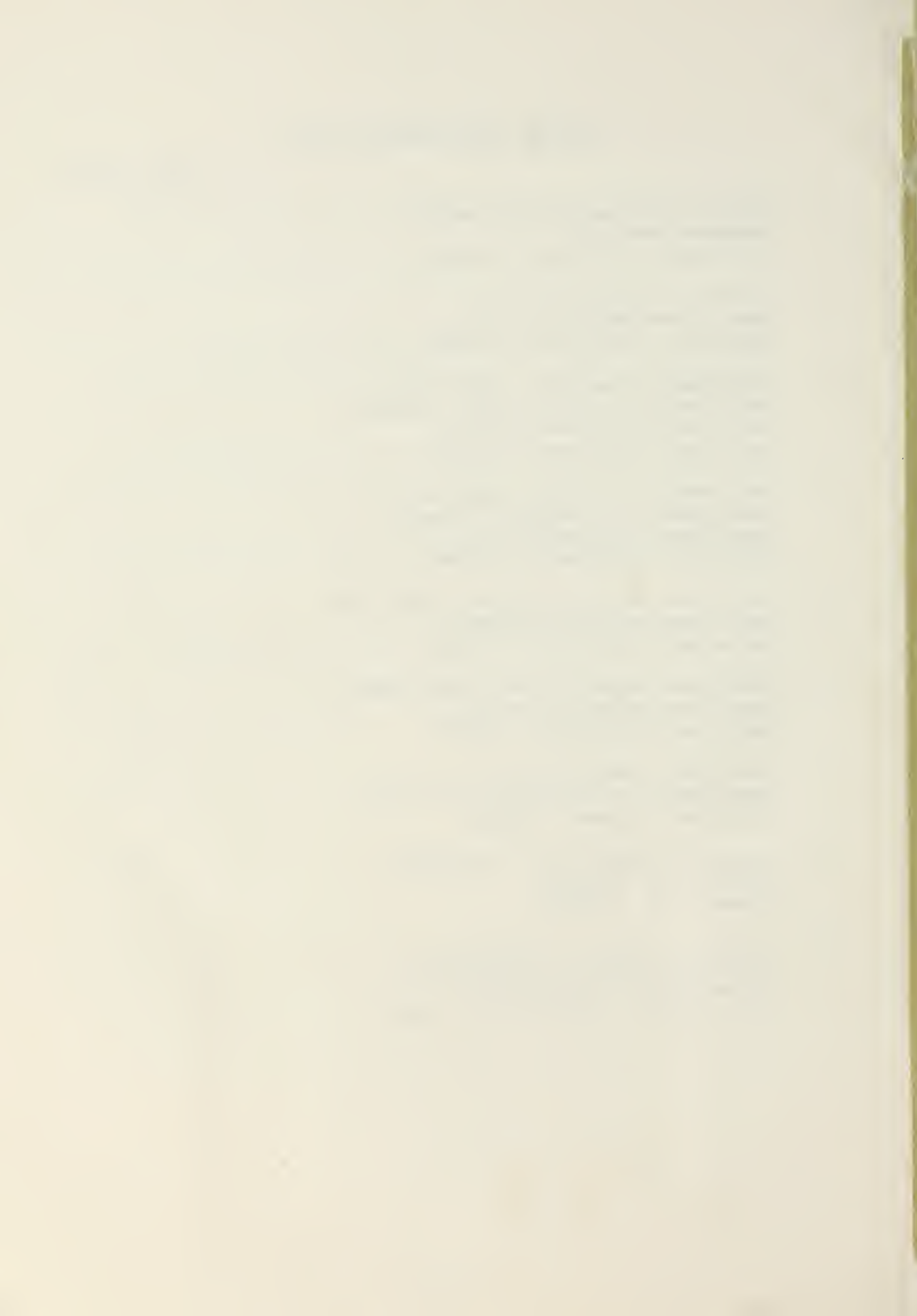
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